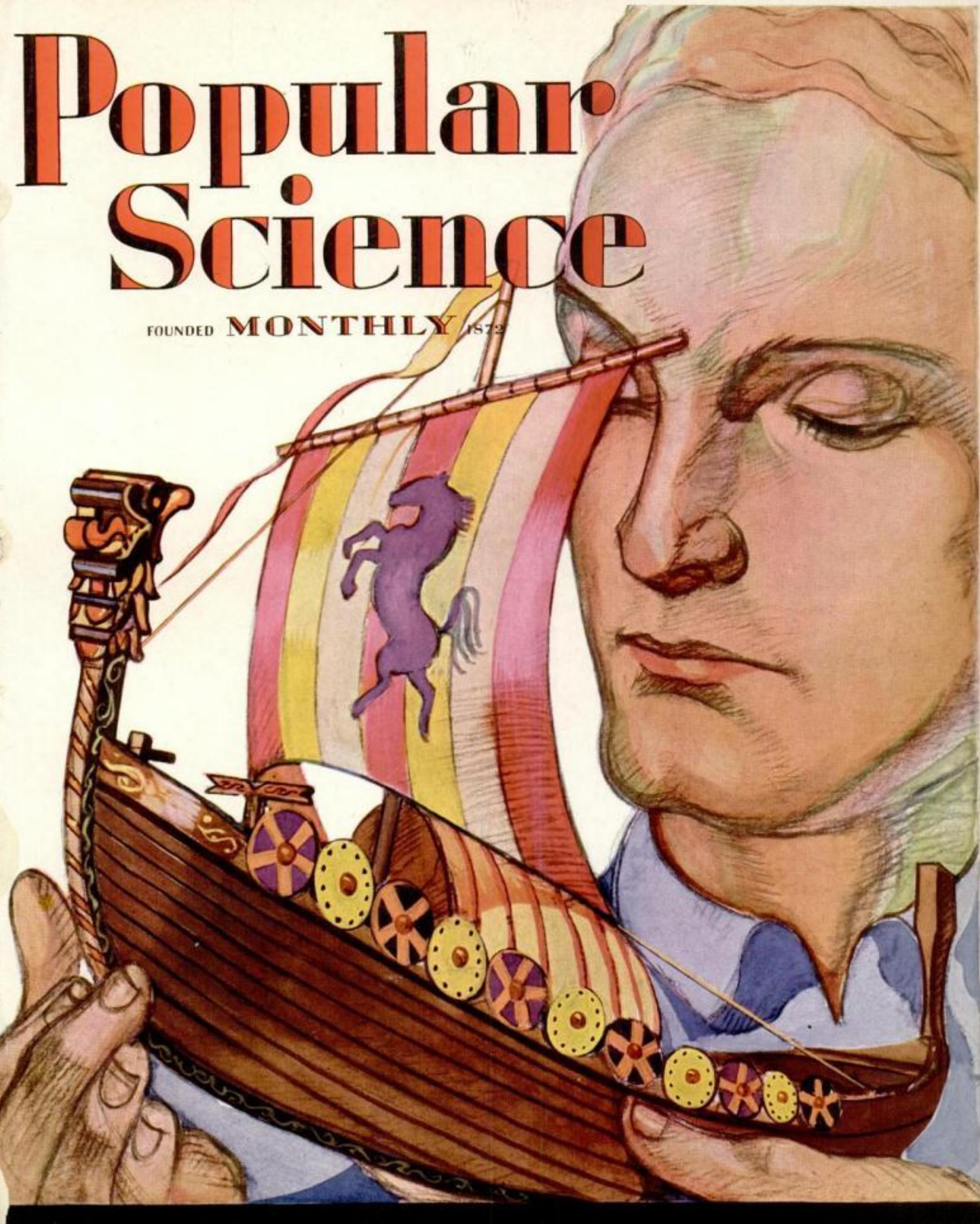


MAGAZINE OF NEW DISCOVERIES AND USABLE IDEAS

Popular Science

FOUNDED **MONTHLY** 1872



A PICTURESQUE VIKING SHIP MODEL
ANYONE CAN BUILD — PAGE 70 25 CENTS

APRIL

BY AIRPLANE
OR
MULE-BACK

There's a radio station in Honduras, six thousand feet high, upon a mountain top. They use Radiotrons there, high power Radiotrons, for transmission. More than once in an emergency, the Radiotrons have had to be delivered by airplane. Usually they are carried up the rough mountainside by mule-back.

These great Radiotrons cost a few hundred dollars apiece, and as not many "spares" can be kept on hand at that price, each one must perform exactly to standard—each one must be sturdy of build in spite of its delicate accuracy.

The laboratories that design these high power transmission tubes design the Radiotrons you use. The same factories make them. The same test laboratories test them. RCA produces the tubes for all sorts of high power transmission and learns from these tubes many a lesson of making and testing that gives you a better Radiotron for your receiving set! Benefit from this experience by using only genuine RCA Radiotrons, no matter what type of tube you use.



RADIO CORPORATION
OF AMERICA
New York Chicago
San Francisco



®

Every tube in your set counts!

Every tube in your set has its "finger in the pie." The faint signal that comes in from the broadcasting station goes through each tube, and it's magnified hundreds of thousands of times before it gets to the loudspeaker.

It's not only important to get the "special" Radiotrons that give you bigger distance and bigger volume. But it's just as important to stick to genuine Radiotrons straight through the set, if you want to keep up its performance. RCA research makes Radiotrons better and better every year!

*Bring your storage battery set up-to-date with
a power RADIOTRON UX-171 or UX-112*

*a detector RADIOTRON UX-200-A
and RADIOTRONS UX-201-A for all-round quality.*

*Bring your dry battery set up-to-date with
a power RADIOTRON UX-120
and RADIOTRONS UX-199 for all-round quality.*

RCA ~ Radiotron

MADE BY THE MAKERS OF THE RADIOLA

Before you buy a used car from a friend—

*Send for
THIS
FREE
BOOK!*



Pledge to the Public on Used Car Sales

- 1 Every used car is conspicuously marked with its price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.
- 2 All Studebaker automobiles which are sold as CERTIFIED CARS have been properly reconditioned, and carry a 30-day guarantee for replacement of defective parts and free service on adjustments.
- 3 Every purchaser of a used car may drive it for five days, and then, if not satisfied for any reason, turn it back and apply the money paid as a credit on the purchase of any other car in stock—new or used. (It is assumed that the car has not been damaged in the meantime.)

To the Public: We pledge adherence to the above policy in selling used cars.

Your Studebaker Dealer

Mail this coupon for your copy

of "How to Judge a Used Car"

If you were about to buy a used car from a friend, would you know how to determine its fair market price? Do you know why some dealers mark their prices in code instead of plain figures? Do you know how to tell what year any used car was built?

You will find the answer to these questions and many others that any buyer of a used car should know in this free book, "How to Judge a Used Car." It tells you what to look for and what to avoid in purchasing a used car. It is based on the long experience of experts in buying used cars for Studebaker dealers—their sound, practical advice may be the means of saving you time and money. Send for it at once!

Studebaker is only too glad to help you get the greatest value in a used car for your investment. Because Studebaker dealers believe in this policy, they have adopted this famous Pledge. Wherever you see this Pledge displayed you can buy a Certified Studebaker with absolute assurance that it is worth what the dealer asks and will do what he says.

THE STUDEBAKER CORPORATION OF AMERICA
Department D56, South Bend, Indiana

Please send my copy of valuable free booklet, "How to Judge a Used Car."

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Street _____

Town _____ State _____

S T U D E B A K E R



THEN AND NOW

AN EDITORIAL

THE other evening I was talking with an old friend. Some twist in the conversation recalled our school days. We began to compare ourselves as we were then with our sons and daughters of today.

"What beats me," said my friend, "is that my youngsters really seem to *enjoy* going to school. Remember how we used to hate it? Remember how we'd rig up all kinds of excuses to stay home, from headaches to torn trousers? But now you can't keep children away from school."

"I wonder if it's because the folks who run the schools have learned how to dress those dry examples, rules and dates in an interesting way? We used to get our knowledge like parrots, without knowing what half of it was about. But now the kids seem to soak it up as easily as playing a game."

Then, a few days later, there came to my desk a letter from a new reader in San Jose, California.

"*POPULAR SCIENCE MONTHLY* is to me the most interesting magazine in the world," he wrote. "I can remember, not so long ago, when I shied at the very word science. To me, and to a lot of others, it suggested ill-smelling rooms, men with long beards and mouthfuls of meaningless terms. But you have changed all that for me, by telling the scientist's story in terms I could understand."

SCCHOOLROOMS transformed from drab prisons of learning to fascinating places of enjoyment! Science, dry and technical, made interesting, understandable—a living inspiring thing! The same basic idea, the same kind of purposeful effort brought about both of these changes.

Month after month it is the effort of the editors of this magazine to strip away the dull cloak which once surrounded science and reveal its true charm and simplicity, its glamor, its romance and its enormous daily value to you and me. It is our purpose to make each issue better than the last.

And when, in last month's issue, we expanded our editorial plan to include fiction for the first time, we were interested to learn how our readers would greet the innovation. The response, as expressed in hundreds of enthusiastic letters already received, was beyond all expectations.

"**G**IVE us more stories like 'Midge,'" wrote one man from Ohio. "For the first time in my life I can experience the thrill of a big steel plant."

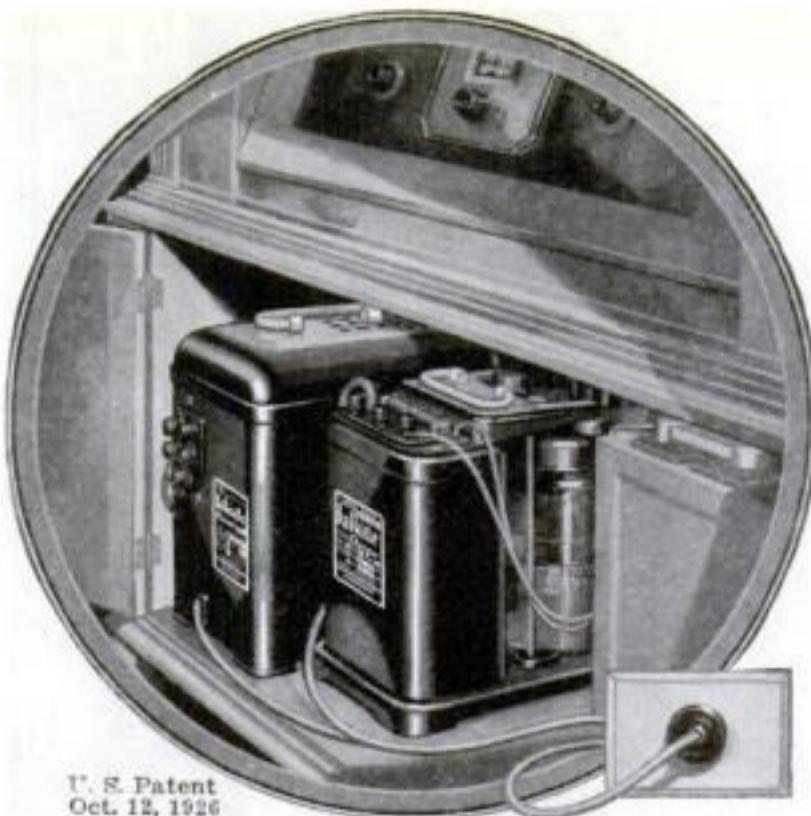
Another, a Texan, wrote: "If the next installment of 'Bare Hands' is as absorbing as the first, we'll need a copy of the magazine for every member of the family."

Hundreds of other letters like these have justified our belief in this entirely new and different way of presenting the great drama of science.

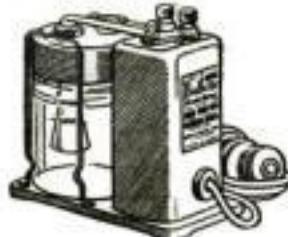
If you did not read the first installment of Hawthorne Daniel's new novel, you can begin it now on page 36. And you won't want to miss Captain Dingle's delightful short story, "Tishy," on page 14.

These, with many timely articles describing new achievements, discoveries and useful ideas, will, we believe, bring the whole tremendous story of science to you in a more enjoyable and worth while way than ever before.—E. C. W.

Silent, permanent radio power *from the light socket*



with Balkite "B" and the new Balkite Trickle and High-rate Charger



Balkite Trickle Charger \$10

For those who require a charger of limited capacity only. Over 350,000 in use. Charging rate .5 ampere. Price \$10. West of Rockies \$10.50. (In Canada \$15.)



Balkite Combination

When connected to your "A" battery supplies automatic power to both "A" and "B" circuits. Controlled by the filament switch already on your set. Entirely automatic in operation. Serves any set now using either 4 or 6-volt "A" batteries and requiring not more than 30 milliamperes at 135 volts of "B" current—practically all sets of up to 8 tubes. Price \$59.50. (In Canada \$83.)

All Balkite Radio Power Units operate from 110-120 volts AC current with models for both 60 and 50 cycles. The new Balkite Charger is also made in a special model for 25-40 cycles.

Over 1,000,000 radio set owners are now using Balkite Radio Power Units because they provide silent, permanent power from the light socket. They are noiseless in operation and can be used during reception. They employ no tubes. They have nothing to wear out or replace. They are built to conform with the Underwriter's standards. Other than a slight current consumption their first cost is the last. Permanent and unfailing in operation, they are based on the same Balkite principle now commonly used in railway signaling, hospital lighting, and numerous other systems where power must be infallible.

One way of equipping your radio set with Balkite is to merely add Balkite "B" and the Balkite Trickle and High-Rate Charger. Balkite "B" eliminates "B" batteries entirely and supplies "B" current from the light socket. It is the proved popular "B" power supply. Of the 150,000 now giving satisfactory service, some of which have been in use for over three years, to our knowledge not

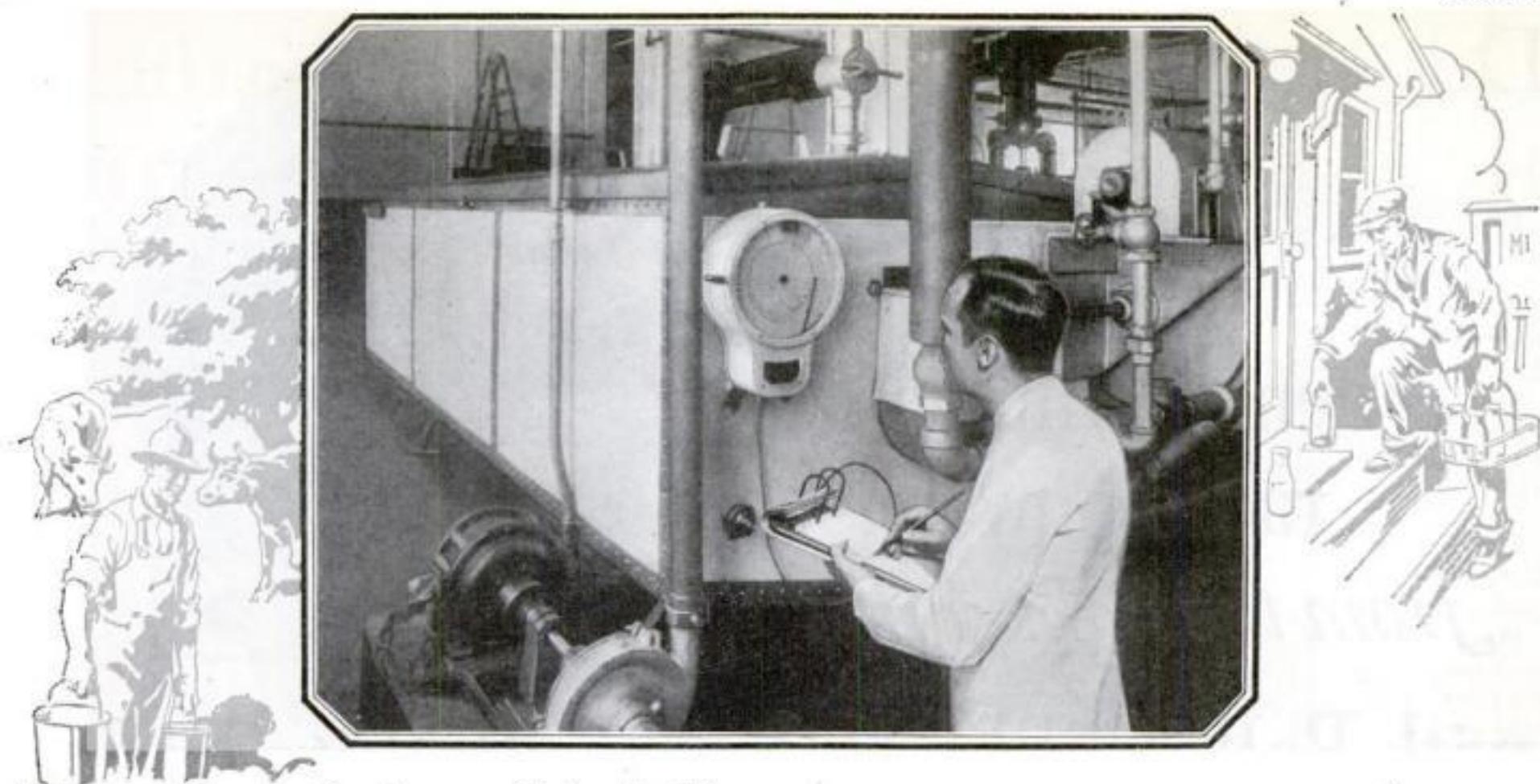
one has ever worn out. The new Balkite "B"-W serves sets of 5 tubes or less requiring 67 to 90 volts, Balkite "B"-X [shown above] sets of up to 135 volts and 8 tubes and Balkite "B"-Y any standard set. Most owners of even small sets will buy Balkite "B"-X which will take care of nearly any set you may buy in future.

The new Balkite Charger with both high and low charging rates is easily the greatest charger value in radio. It combines the advantages of both trickle and rapid charging. At the low rate, on trickle charge, it automatically keeps your "A" battery fully charged, and in effect converts it into a light socket "A" power supply. Its high rate provides an ample reserve of power for the largest sets.

Add these Balkite Units to your radio set. Then you will enjoy the last word in radio convenience, and silent, unfailing power from the light socket. Ask your dealer. Fansteel Products Co., Inc., North Chicago, Illinois.

*Balkite "B"-W \$27.50; "B"-X \$42; "B"-Y \$69; Balkite Charger \$19.50; West of Rockies \$20;
(In Canada "B"-W \$39; "B"-X \$59.50; "B"-Y \$96; Charger \$27.50.)*

FANSTEEL
Balkite
Radio Power Units



The health of Millions is protected by *Tycos* - the Sixth Sense

TO KILL any communicable disease germs which may be in the raw milk as it comes from the farm, milk is pasteurized. *Tycos* Instruments are an important factor in pasteurization—and pasteurization protects the health of millions.

The largest creamery in Detroit uses 30 *Tycos* Temperature Recorders and 15 *Tycos* Temperature Regulators to insure the proper pasteurization of their milk. One of the largest dairies in Cleveland says they are saving \$4,800 a year through the installation of *Tycos* Recording and Regulating Instruments. In this plant *Tycos* Instruments are paying for themselves every two months. And in addition they are making big savings in preventing spoilage.

Tycos Instruments for indicating, recording and controlling temperature are the Sixth Sense of Industry. They are saving labor costs, eliminating loss through spoilage and insuring uniformity of production in all branches of industry where the indicating, recording or controlling of heat is required.

Whether you make steel or bread, furniture, ice cream, tools, candy, or any other product that goes through manufacturing processes that require the indicating, recording or controlling of temperature, there is a type and style of instrument in the *Tycos* line of 8000 varieties that will help you. Informative literature on any type of instrument will be sent you promptly on request. Or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

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SHORT & MASON, Ltd., Manufacturing Distributors in Great Britain

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An aid in promoting human efficiency.

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To enable you to get the most good from your bath.

Taylor Home Set

Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in Cooking.

Tycos Wall Thermometers

To help you maintain a temperature in your house conducive to good health.

Taylor Quality Compasses

To show you the right way in unfamiliar country.

Tycos Fever Thermometers

A necessity in every home.

Tycos Stormoguide

Forecasts the weather twenty-four hours ahead with dependable accuracy.

Tycos Hygrometer

To enable you to keep the humidity of the atmosphere in your home correct at all times.

Tycos for the Medical Profession

Tycos Sphygmomanometer, Pocket and Office types.

Tycos Urinalysis Glassware

Tycos Fever Thermometers

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above

Write for *Tycos* Bulletin



THE ~ SIXTH ~ SENSE ~ OF ~ INDUSTRY
Tycos Temperature Instruments
INDICATING ~ RECORDING ~ CONTROLLING

This One



LFO1-SRG-BLD1

Do you dream of *Independence* for them?

HOW much more rich will life be if you realize that each day is leading you towards a certain financial independence amid ideal working and living conditions? How much better for them!

Talk over with your wife the new plan which the financially powerful Brotherhood of Locomotive Engineers has worked out at Venice, Florida, to supply a basis of future independence for people who will operate business farms on soil of high fertility, backed by the experience and advice of the Venice Farm Board.

The Brotherhood, with sixty-three years of experience devoted to the improvement of living and working conditions, has made arrangements so that earnest people of moderate means can purchase Venice Farms on liberal terms—fronting on good roads cleared and ready to plant, with main drainage available.

Here the Farm Board operates Demonstration Farms, the Venice Nursery, and the Venice Dairy Farms, the facilities of which are available to Venice Business Farmers.

People are coming here who never dreamed of farming before. It is business farming—entirely different from the old-fashioned drudgery so long associated with farm life. Here nature lends a helping hand, crops grow bountifully and fast, and bring highest prices in early winter markets.

Here is year around out-door life under an ever-shining, life-giving sun. Every farm is in easy driving distance of the new model city of Venice. In this community an ideal life and real independence is possible. There is the confidence given by the Brotherhood's financial strength, practical help by men who know Florida farming, the companionship of people who have already embraced the opportunity and are on the ground, and finally nature's own best co-operation.

Venice a natural all-year resort

Venice life is divided between agriculture, industry and resort activities. Vacationists remark the variety of diversions. Here one finds the West Coast's only mainland beach and its most famous fishing grounds. Here is a modern city planned and built by experts which fronts on the beach. Adjacent to it is what visitors call the largest and most comprehensive farm development ever projected in America . . . Venice hotels serve fruit, vegetables, milk and cream received fresh every day from Venice Farms near-by. Conveniently located are well-kept golf courses, tennis courts, quoits and other games, and excellent hunting and fishing are found in the tropical Myakka River and its valley. Hotel rates from \$5.00 to \$15.00, with 60% of rooms at \$5.00.

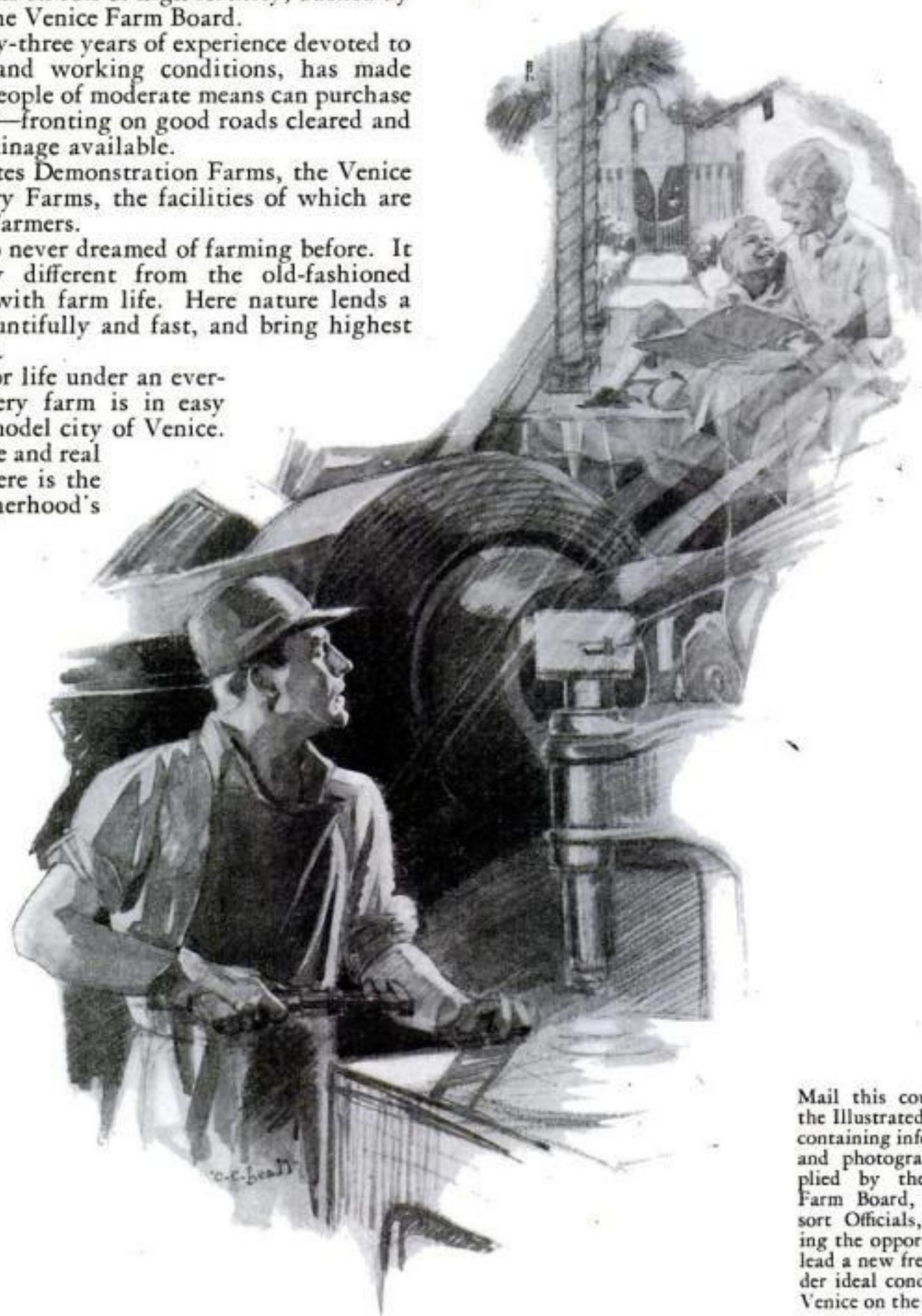
THE VENICE COMPANY
Owned by The Brotherhood of
Locomotive Engineers

We limit this advertising to demonstrable facts supplied by the Venice Farm Board and officials in charge of the City of Venice

Come to
National Tarpon
Tournament
at Venice
June 4th to 25th

Venice Florida

THEN LIVE THIS NEW LIFE



Mail this coupon for the Illustrated Booklet containing information and photographs supplied by the Venice Farm Board, and Resort Officials, describing the opportunity to lead a new free life under ideal conditions at Venice on the Gulf.

THE VENICE COMPANY

113 Venice Boulevard, Venice, Florida

Please send me the booklet, containing information and photographs supplied by the Venice Farm Board and Resort Officials, describing "A New Life of Independence" possible under the pleasant conditions at Venice.

Name

Address

Present Occupation

A BUDGET PLAN

That Will Help You Get Ahead

By WALLACE AMES, *Financial Editor*

DON'T talk to me about budgets," expostulated Ted Carter. "We've tried them all, and all we have to show is a lot of loose leaf books, special forms and cash accounts which never would balance. Why, we set out the first of this year dead-set on making a budget work and already it is way out of joint."

The bond salesman was undiscouraged. He had been up against just this situation before. "I know the answer to your problem," he said, "and right now I am more interested in helping you to work out a successful budgeting plan than I am in selling you a bond. If you adopt the plan I want to show you, you will be able to buy bonds regularly."

"All right, let's have it," consented Carter, still unconvinced.

"To begin with," continued the bond man, "the trouble with all the budget plans you have tried is that they involve too much pesky detail. They do not take into consideration that you and your wife are two individuals, with ordinary human weaknesses, not a strict business concern with its systems and rigid rules. You get tired of keeping a cash account of pennies spent for newspapers; you lose interest when something unexpected comes up and, 'throws your budget out of joint.'

"Probably you have tried a number of set budget forms, standardized systems which you got in some store. These 'ready-made' systems allow a certain percentage of your income for this, a certain percentage for that, but their allowances don't fit your case. You have been trying to squeeze your personal financial budget into a 'ready-made' plan and it doesn't work any more than a square peg fits in a round hole."

"IN THE first place, I want to show you how to design a budget plan *to order*, adjust and suit it to your circumstances.

"In the second place, I think I can show you how to operate a budget with a lot less bookkeeping than you have been bothered with in the past. Of course you will have to keep some accounts, but the amount of them can

be greatly reduced and simplified so that they will not be tiresome. And the result—your gain in satisfaction as well as in cash conserved—will be a rich reward.

"What is a budget, anyway?" asked the bond man, and then proceeded to answer the question himself. "It is a division or apportionment of your income so that you are spending the proper amount on various things. It is the one way to keep you out of financial holes. It is the only way you can be sure of having money for the things you need —when you need them."

LEAT US begin, then, in your 'made-to-order' budget, by separating into two classes your *Fixed Charges* and your *Fluctuating Charges*. Your fixed charges consist of definite or easily controlled items such as rent, taxes, insurance premiums, savings, etc. Fluctuating charges consist of items which are subject to wide variations, such as clothes, provisions, entertaining, medical aid, etc.

"After your fixed charges are determined and provided for, you can practically forget them and concentrate on controlling the fluctuating charges, where the leaks are most likely to occur. This plan will also reduce the amount of account keeping you will have to do."

Then the bond salesman took out a paper on which he had written a general analysis of fixed and fluctuating charges. He gave this to Mr. Carter to use as a guide only. It was up to Carter to figure out what his own fixed and fluctuating charges were and what amount of his total income to reserve for each one. The general analysis on the memorandum paper was as follows:

FIXED CHARGES

- A. *Accumulation*: Savings; investment; building and loan shares; payments on mortgage; life insurance.
- B. *House*: Rent; interest on mortgage; property taxes; fire insurance.
- C. *Operation*: Ice; gas; electricity; coal; telephone; servants; laundry; clothes repair.
- D. *Automobile*: Garage rent; insurance; payments on note; licenses.
- E. *Special*: Allowances to dependences; personal taxes; dues; charity; education; vacation.

FLUCTUATING CHARGES

- A. *Food*: Provisions; meals eaten out.
- B. *Auto Maintenance*: Gasoline and oil; repairs and adjustments; accessories.
- C. *Diversion*: Recreation; entertaining; exercise; books and magazines; hobbies, such as camera or radio or workshop.
- D. *Contingencies*: Household supplies; new furniture; house and household repairs; doctor, dentist and nurse; drugs, etc.
- E. *Personal*: Clothes; gifts; tobacco; candy; cash for miscellaneous items such as carfare.
- F. *Special*: To provide against necessary expenditures in excess of the regular budget allowance a small amount should be reserved to add as necessary to any of the established charges.

"Now," resumed the bond man, after they had looked over the memorandum, "let me make a few suggestions as to how to put your 'made-to-order' budget into operation.

"Tackle the fixed charges first. Make a memorandum on one page of the amount you need to put in the bank every week or month so that you will have enough money to meet these fixed charges when the bills come in. You can then determine how much of every pay check you will have to deposit to take care of fixed charges. There is no further account keeping on these. Your check book stubs are all you need."

TOtal up the amount of all fixed charges and subtract it from your gross income. The remainder you have to divide over fluctuating charges. Make a memorandum of these on another page.

"The only cash account you or your wife will have to keep is one of money spent on the fluctuating charges. *And you both will have to train yourselves to keep your fluctuating expenses within the amount allotted.*

"Get an ordinary memorandum book. Start a page for your current expenditures of each item in your fluctuating charges. Keep track of money spent and see that you do not go over your allotment."

Most of us find that operating a budget is such a nuisance that good resolutions to do it are often broken. Yet, living on a budget basis is extremely important in the business of getting ahead, and the Simplified Budget Plan outlined in this article will help you.



Judgment

When you till the soil you put your trust in nature. But you use judgment, also, in the planting.

In much the same way, investing calls for confidence in others. But judgment should guide you to the proper institution—one of proved experience, integrity and conservatism.

As you consider Fidelity Guaranteed First Mortgage Bonds, at 6½%, we urge you to confirm their safety by investigating the company that sponsors them. Our booklet, "The House Behind the Bonds," will aid you. Send for it, without obligation.

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BOND & MORTGAGE CO.

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1188 New York Life Bldg., Chicago
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FIDELITY GUARANTEES EVERY BOND

A Service for Readers

THIS Financial Department is to help readers in the establishment of proper financial programs at the beginning of their business careers; it assists those who have accumulated money in the proper investment of it so that it will be safe and so that it will grow.

The Editor of this Department is an authority on investment matters and he will not only every month give the readers interesting and useful information in his articles, but is also ready to aid in personal investment problems. Advice will be gladly given regarding the proper investment of funds and proper plans of saving.

Address all your inquiries to Wallace Ames, Financial Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

Any advertising appearing in this section will be carefully investigated by the Publisher of POPULAR SCIENCE MONTHLY. Readers can be sure that companies advertising are reliable and that they offer securities which represent sound financial investments. While investments obviously cannot be guaranteed by the Publisher, every effort will be made to insure that only advertisements of absolutely reliable companies are accepted.

Booklets that Will Help You Get Ahead

ANYONE with money available for investments will find the booklets listed below of help in getting ahead financially. You may obtain any of these booklets by writing direct to the issuing house. It will be appreciated if you mention POPULAR SCIENCE MONTHLY when writing for booklets.

How to Build an Independent Income (1927 Edition)—Describes a plan for buying 6½% First Mortgage Bonds by payments of \$10 or more a month, and shows the results that may be accomplished by systematic investment at 6½%. For copies address: The F. H. Smith Company, Smith Building, Washington, D. C. Ask for Booklet 75.

Why Your Real Estate Bonds Should Be Guaranteed is the self-explanatory title of a booklet on a subject of wide interest among investors in Real Estate bonds. Address: Adair Realty & Trust Co., Healey Building, Atlanta, Ga. Ask for Booklet P. S.-2.

Forty-four Years Without Loss to Any Investor presents the safety record of this house and describes the safeguards constituting the Straus Plan. Address: S. W. Straus & Co., Desk P, Fifth Avenue & 46th Street, New York, N. Y.

The Strength of the Utilities, with illustrations, charts and layman's language, presents facts that every investor should know regarding the public utility industry. Address: Halsey, Stuart & Co., 201 So. La Salle St., Chicago, Ill. Ask for Booklet P. S.-S. U.

The Making of a Good Investment explains the methods employed by the United States Mortgage Bond Co. in originating first mortgage bond issues which pay 6% with principal and interest guaranteed, or 6½% without the guarantee, which is optional with the investor. Address: United States Mortgage Bond Company, 365 U. S. Mortgage Bldg., Detroit, Mich.

An Investment Insured for Its Lifetime describes a plan of insured mortgage investments. Nine points of safety are explained. Address: Mortgage Security Company of America, Norfolk, Va.

Rules for Safe Investments explains in language that the layman can understand the important factors of safety of real estate bonds. Address: American Bond & Mortgage Company, 345 Madison Avenue, New York, N. Y., and ask for Booklet P. S.-40.

Buying Bonds by Mail explains how the investor may safely and conveniently deal with an investment banker through the mails, and without the usual advantage of direct contact. Address: A. C. Allyn & Co., 67 West Monroe Street, Chicago, Ill. Ask for Booklet D. E.-2450.

Your Money covers the points of general interest to the investor who is planning to put his money in sound mortgage bond investments. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Bldg., Chicago, Ill.

Investment Service explains the service given by a first mortgage bond house. Address: Federal Bond & Mortgage Co., 1444 Griswold Street, Detroit, Mich.

The Science of Fortune Building, published by George M. Forman & Co., is the explanation of practical, tested plans employed by investors to attain financial independence. Address: George M. Forman & Co., 164 West Monroe St., Chicago, Ill. Ask for Booklet 833.

Investors' Guide, published by Greenebaum Sons Investment Company, combines a description of "bank safeguarded" bonds with an outline of the service of that company. Address: Greenebaum Sons Investment Co., 9 So. LaSalle St., Chicago, Ill.

You, too, can build an INDEPENDENT INCOME

with **6½% SMITH BONDS**

TODAY, when means are provided for thrifty men and women to invest their savings in sound securities, the way to financial success is open, and the rules are simple and few:

- 1 Set aside a part of each month's income as capital;
- 2 Invest that capital in good bonds to produce more income;
- 3 Insist upon safety.

The longer you follow this method, the faster your money grows; for, obviously, the more income you receive the more bonds you can buy, and the more bonds you buy the more income you receive. As to the third rule, by insisting upon safety you make sure that you will hold all of your gains.

SMITH BONDS combine the interest rate of 6½% with the security of first mortgages on modern, income-producing city property, and with safeguards that have resulted in our record of

No Loss to Any Investor in 54 Years

As a result of this record, confidence in **SMITH BONDS** is world-wide. Men and women in 48 States and in 51 countries and territories abroad have bought **SMITH BONDS** by mail.

You may buy **SMITH BONDS** in \$1,000, \$500 and \$100 denominations, outright for cash, or under an Investment Savings Plan that pays the full rate of bond interest—6½%—on regular monthly payments of \$10, \$20, \$30, \$40, \$50 or more.

Mail the form below for our booklets, "Fifty-Four Years of Proven Safety" and "How to Build an Independent Income."

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Name..... 75-1

Address.....

This graph shows the very definite type of information the Popular Science Institute has on oil burners as a result of its investigations among 3,000 oil burner owners

Do You Know How to Pick a Good Oil Burner?

A MAN who recently had an oil burner installed in his home was telling how he went about selecting it. I marveled at the haphazard, even careless, way he had made his choice and yet I knew him to be a shrewd and careful buyer of other things that cost a fraction of the price of an oil burner.

In buying an overcoat, a piece of jewelry, or even a pipe, I know perfectly well that this acquaintance of mine would never have been willing to make his selection on the basis of what information he had gathered from a friend or two, or some salesmen. He would have judged for himself, or else made inquiries of someone better informed and entirely impartial.

But in buying an oil burner, he had been up against a different proposition. Here he was investing several hundred dollars and yet had no gage of past experience or source of expert advice to aid him in his purchase. So this major investment was made on a guess, a lucky one, fortunately. He selected (or, rather, blindfoldedly drew) a burner which our Popular Science Institute of Standards has found to be one of the very best, after thoroughly investigating some three thousand installations of oil burners.

Guesswork, as most people realize, is not a safe way to go about selecting anything. Now that the Popular Science Institute has extended its activities to include the investigation of oil burners, you can buy these marvelous new labor savers without resorting to guesswork. Already, twelve hundred readers of POPULAR SCIENCE MONTHLY have come to us for advice in installing oil burners in their homes.

By PROF. COLLINS P. BLISS, Director
Popular Science Institute of Standards

They have reasoned that it is considerably safer to go by the experience of three thousand people than that of the few oil burner users among their acquaintances.

In investigating these three thousand installations, the Popular Science Institute of Standards has not confined its search to any one city or section of the country. A comprehensive and fair picture of just what degree of satisfaction oil burners are giving, and which of those on the market are good, was gained by covering installations in small towns and cities scattered all over the country from Maine to California.

We asked these oil burner owners how long they had had their burner installed, how many service calls had been required, what kind of service

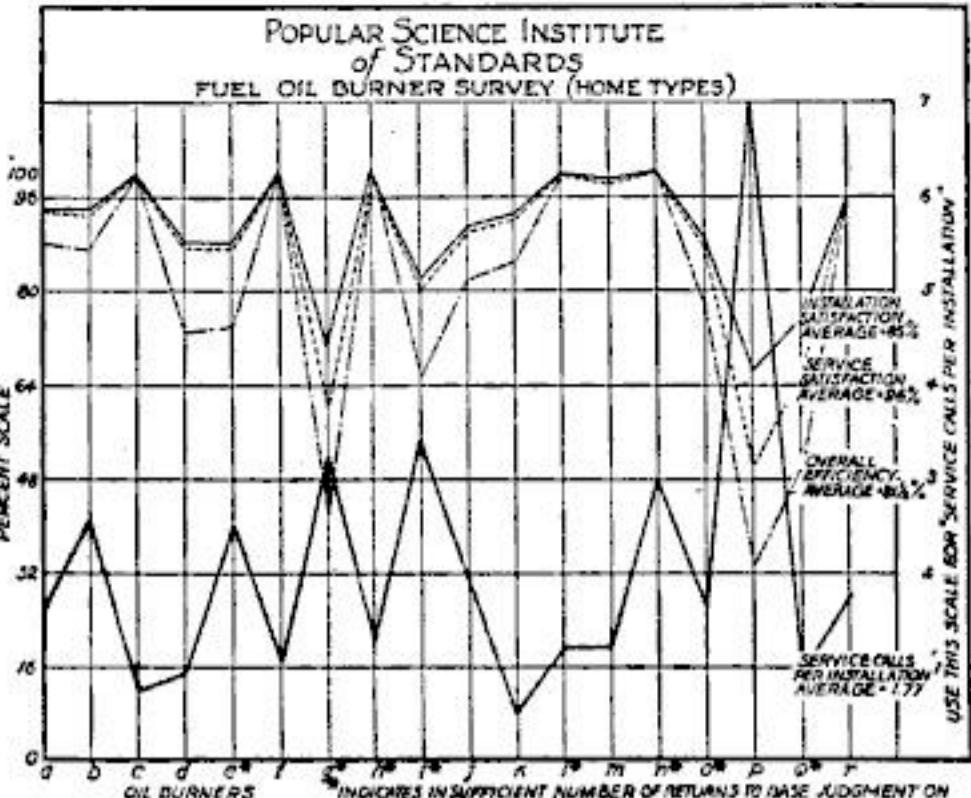
they received, whether their burner was costing them more or less than using coal as a fuel, how much more they would be willing to pay for oil before they would go back to burning coal, whether there was a disturbing noise from the burner and, finally, were they satisfied with the burner as a whole. When we got through asking all three thousand owners these questions, we were able to judge just which burners could be purchased with the positive assurance they would give satisfaction.

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3. Average coal consumption per year.
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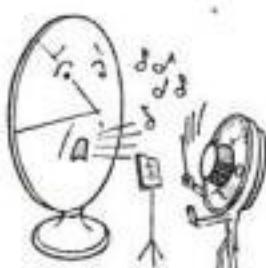
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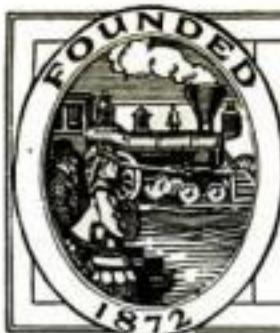
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POPULAR SCIENCE MONTHLY

SUMNER N. BLOSSOM, Editor

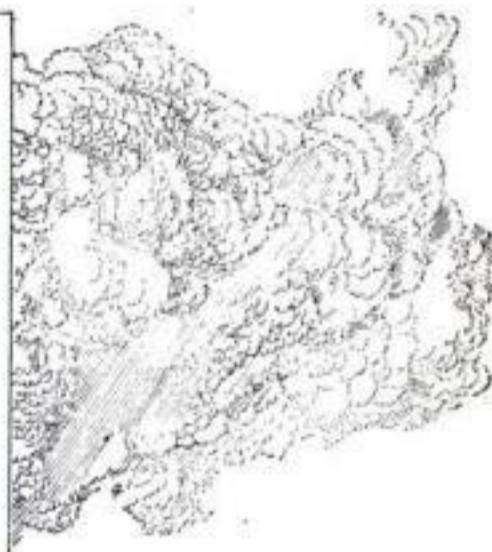
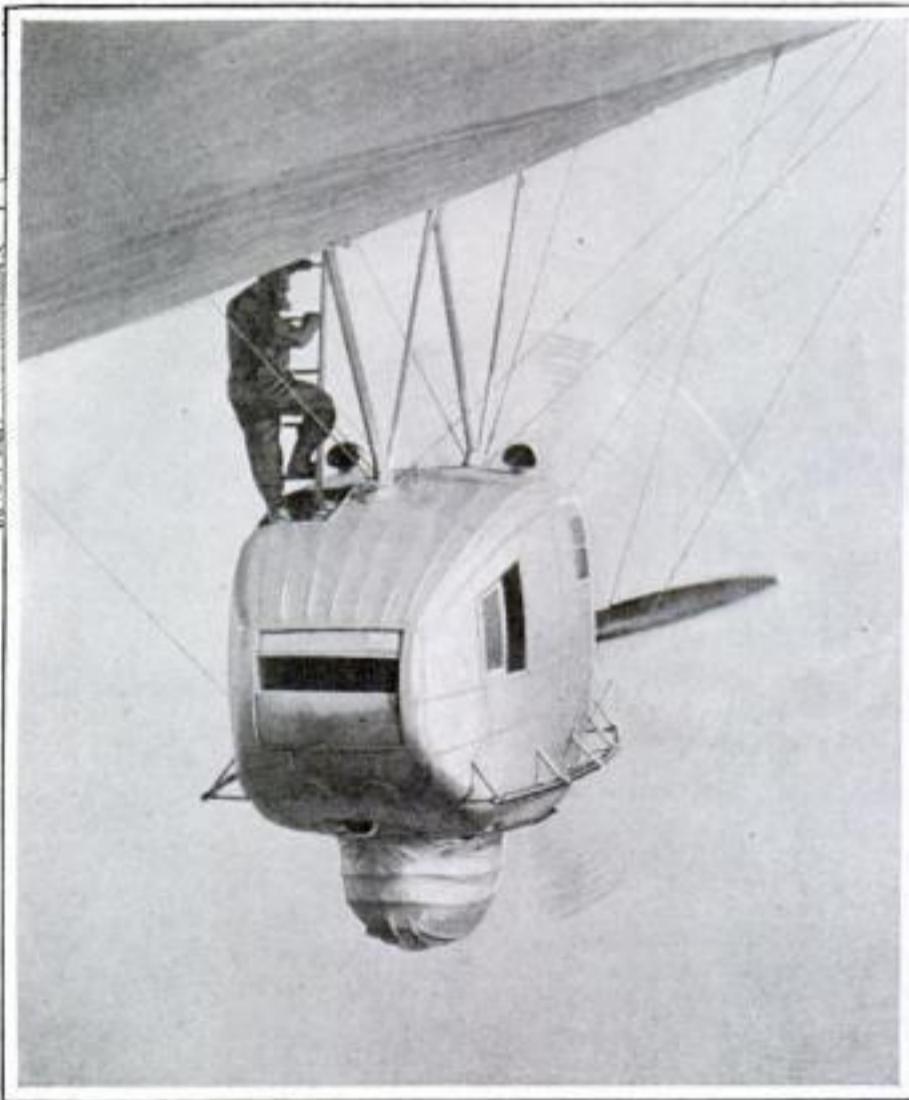
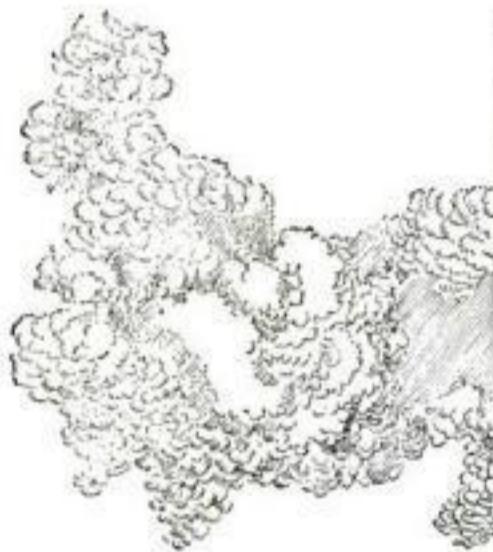
April, 1927



A Job for One in a Million!

Why Only a Few Men Can Photograph Cities, Chart Forests, Explore Jungles from Aircraft

By H. A. BRUNO



SIX thousand feet above the town of Corning, Iowa, two veteran airmen swept across the blue sky in an old war-time De Haviland plane, making a photographic air map of the countryside below. At the controls sat Harlan Guerney, ex-war pilot, intent on battling a stubborn wind that tried to thrust his machine from the course charted on a survey map before him. In the rear cockpit A. O. Russell, photographer, bent over the adjustments of a huge camera, whose searching eye protruded downward through a hole in the fuselage.

The camera was clicking off its exposures with monotonous regularity when suddenly, with a deafening blast, the big 400-horsepower motor backfired, igniting the gas-filled carburetor. Instantly the plane, and the men who rode it, were enveloped in flames.

Guerney turned for one grim glance at his companion; then, with the instinct born of experience over the battle lines, he threw the plane into a sideslip. It was the one desperate chance, he knew, to blow the flame to the side and away from their faces.

Downward they plunged, a ghastly

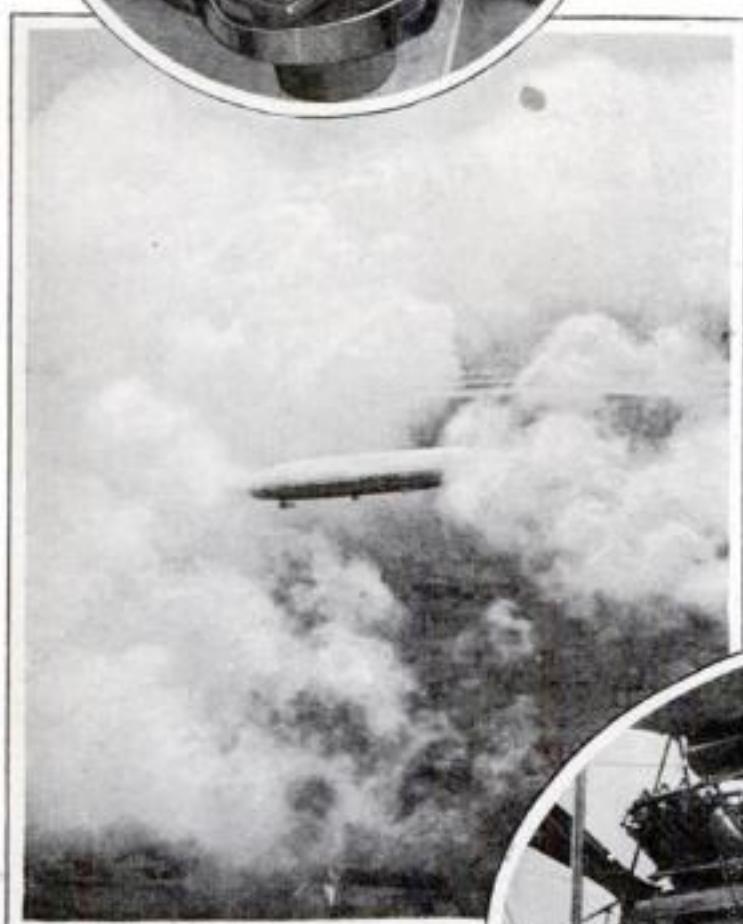
torch from the heavens. Russell braced himself for the crash. Just when death loomed as inevitable, Guerney, in a last frantic effort, with his face already blistered by the terrific heat, flattened the plane out of its sideslip in time to make a landing in a clear field. The fiery thing bounced wildly along the ground, and as it came to a stop the pilot dove headlong through the flames and over the side. Scrambling to his feet, he looked for his comrade. What he saw was Russell struggling over the edge of the cockpit, his precious camera clutched tightly

in his arms! A few moments later the machine was a smoldering skeleton.

But the next day they were back on the same job in another plane. That is the way of the aerial photographer and the photographic pilot, side partners in a remarkable new profession which is blazing trails, for the progress of industry and discovery. This thrilling episode of last Armistice Day simply typifies the unbeatable spirit, grit and skill of men who today are following the adventurous footsteps of pioneer surveyors of the past who plunged with rod and transit into unknown spaces, charted wildernesses,

and wrote new frontiers on the maps.

TEEN years ago the science of aerial photography was virtually unknown beyond the battle lines of the war, where it played a vital rôle. Yet even then there were young Americans who, looking into the future, saw a great opportunity for peace-time use of pictures from the sky. They visioned themselves soaring high among the clouds and, with eagle eye, surveying the face of the earth far below; mapping its mountains and streams, its crowded centers of industry.



The last air photo of the ill-fated *Shenandoah* plowing through the clouds, as a birdman saw her. Above: Capt. A. W. Stevens, noted sky photographer, charting Brazilian jungles with his "aerial eye"

Today scores of these eagle men are flying over the countryside with their remarkable cameras; some of them so high that while they can peer down through lenses and make visible, permanent records of your house and lot, office or factory, they are completely lost to your sight from below! Braving all weather, risking the bumping of winged ships in tricky air currents, trusting their lives to the smooth running of machinery, often facing the peril of a forced landing in the wilds, they are performing a service of ever-increasing value.

BY MAPPING entire cities from the air, they have revealed at a glance solutions to difficult problems of traffic and city planning. In the rôle of timber cruisers, they have surveyed and mapped thousands of square miles of forest lands, not only charting the locations of varieties of timber, but making possible an actual count of the standing trees.

They have aided in planning great industrial plants; laid down the right-of-ways for power lines, charted fire hazards, solved the tangle of railway terminals, charted golf courses, promoted real estate development. And finally, they have

penetrated remote and unexplored regions, bringing to light vast resources of unused power and wealth. All these things have been made possible by the invention of marvelous automatic cameras, under the long-range scrutiny of which no detail can escape.

One of the most remarkable and valuable of all the achievements of this new engineering science was the mapping of Greater New York from the sky—a task that required some 3,000 miles of flight and embraced a territory of 625 square miles. In all, 2,000 separate exposures were required to include the city's five boroughs. But when matched together to form a map, true to scale, the photographs portrayed in minute detail every building, thoroughfare, nook and corner of the great metropolis; even hurrying crowds and traffic congestion were plainly visible.

But of all the exploits of flying surveyors, few have surpassed the more recent adventures of the little group of Navy pilots and camera men who, under the command of Lieut. Ben. H. Wyatt, U.S.N., flew last summer over un-

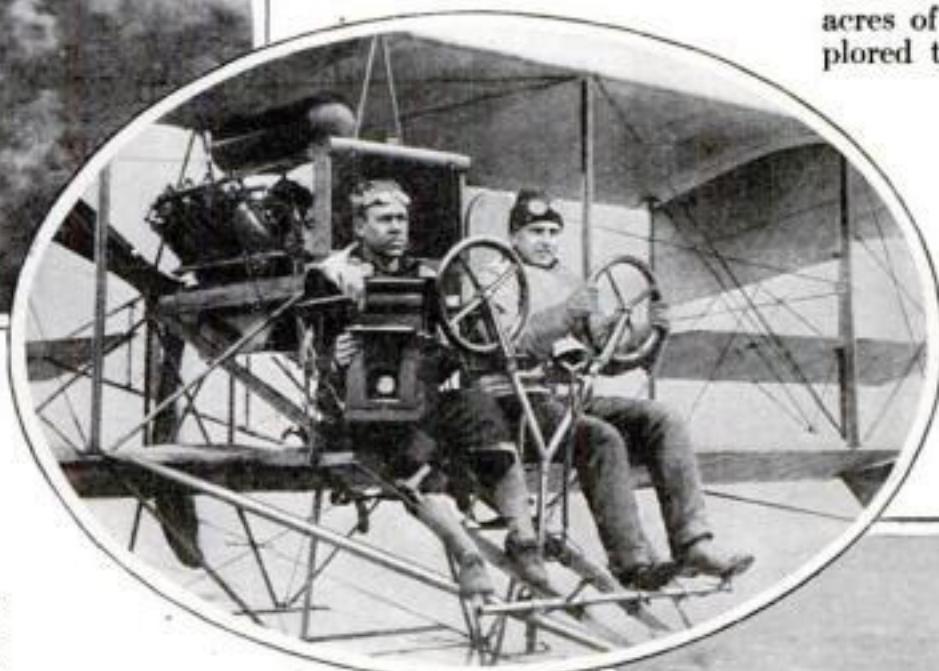
ers, establishing supply bases first at Ketchikan, then at Juneau, Wrangell and Petersburg, ventured in two camera planes out over unpenetrated forests and rugged mountain ranges, leaving behind them one emergency plane to take up the search should one of them fail to return on schedule. Climbing to a height of more than two miles above sea level, they skimmed over snow-capped peaks, or looked down from giddy heights into deep wooded valleys. And always as they flew they were face to face with peril. Anywhere in that wild, uninhabited land, engine failure and a forced landing meant disaster.

And yet they carried on the survey with incredible speed. Equipped with ingenious three-lens cameras capable of making three exposures simultaneously, and flying at a speed of a hundred miles an hour, they were able in one hour to map a strip seven miles wide and one hundred miles long, or 700 square miles. On the average they surveyed a thousand square miles a day. In 385 flying hours they traveled more than 35,000 miles!

THEY discovered, incidentally, hundreds of new lakes and rivers, many of them potential sources of immense power to turn the wheels of industry in the Far North. They found millions of acres of priceless timber. And they explored treacherous rivers that have run

rich with gold, and ancient glaciers reaching icy caps thousands of feet into the sky.

When at last they returned from their hazardous venture, with every plane intact, they brought back not only a remarkable pictorial record of discovery, but proof of the practicability of aircraft for the most difficult kind of surveying and exploration.



Side partners from the beginning—camera man and pilot, braving the hazards of the air with 1914 style plane

explored and forbidding fastnesses of Alaska, completing in three months a survey of Uncle Sam's last frontier that otherwise might have required ten years of struggle through all but impassable wilderness. This achievement followed closely upon that of Capt. George H. Wilkins, the Polar explorer, to whom belongs the credit of taking the first aerial photographs far up in the Arctic Circle.

To the blinking eye of the camera, automatically recording all it saw, Alaska's rich storehouses gave up new secrets. The Navy fli-



Mapping New York from the sky—pieced together, the 2,000 exposures made portrayed every building in the metropolis

Aerial photography is no one-man game. It is an extremely exacting business which calls for perfect teamwork between pilot and camera man. They share adventures and dangers together. They must combine courage and resourcefulness with quick wit and scientific accuracy.

If you could travel with them on one of their mapping trips, you would realize quickly why these qualities are needed. The pilot must guide his plane back and forth along imaginary parallel lines or "strips" until the entire area to be surveyed has been photographed. As he flies, a long roll of photographic film passes automatically through the camera and is exposed automatically at regulated intervals, producing a succession of photographs. The procedure, in effect, is the reverse of that for a motion picture; the camera moves, while the objects are stationary.

SINCE all the photographs obviously must be to the same scale, the first job of the pilot is to keep his ship always at the same altitude—no mean task when you consider that the air is full of invisible bumps and pockets. Moreover, to keep to his imaginary line, he must make allowances for side drift in a cross-wind; sometimes he must "crab" along his imaginary guide line with the plane pointing in an entirely different direction. Add to that the jobs of constantly checking his instrument dials and gages, guarding against rocking and pitching, maintaining a constant speed, and at the same time craning his neck over the cockpit to get his bearings, and you'll see that almost any other kind of driving is child's play in comparison. As one photo pilot expressed it:

"If you really want to know what it's like, try walking

sideways on stilts along a crack in the floor while viewing the crack through the small lenses of binoculars!"

Small wonder experts say that only four or five out of every hundred trained airmen can become photographic pilots.

AND the camera man is much the same sort of busy, cool-headed individual. His chief concern is to time the consecutive exposures of the film in accordance with the speed of the plane, and in such a way that they shall overlap each other like shingles, so that not a single spot in the area under survey will be missing when the photographs are fitted together in the mosaic map. Also, he must continually adjust his camera to make up for any deviation of the plane from its course.

In the routine of their work the aerial map makers have come upon more than one astonishing discovery. A short time ago, for example, photographers flying on a survey over Connecticut succeeded in lowering the tax rate in five towns by discovering and locating "lost property" which

Courtesy Petrichild Aerial Camera Corp.



Remarkable photograph of Niagara Falls, showing the American and Canadian falls and Suspension Bridge, taken by Major Hamilton Maxwell. Upper photo: "Shooting" at long range with one of the marvelous new aerial cameras



Bull moose in a remote mountain lake of Quebec, surprised by a daring sky photographer

had escaped the tax assessor's list. When the photographs were developed, they disclosed hundreds of houses, barns and other buildings on which no taxes had been levied. In one town, the aerial survey revealed 1896 buildings, including 248 stores on the main street, which had gone tax free, with the result that the camera men were instrumental not only in cutting the taxes of individual residents, but in adding millions of dollars to the public treasury.

Another strange discovery made some time ago during an aerial survey remains an unsolved mystery. On a map-making trip north of New York



Indian encampment in Brazilian jungle, never before seen by white man and discovered by the all-seeing camera's eye

City photographers had occasion to fly above the Hudson river. Later, when the photographs were developed, one of these disclosed two submarines lying beneath the waters of the river!

Quick communication with naval authorities established the fact that none of Uncle Sam's submarines was operating in that vicinity. And, since it was peace time, there was no cause to suspect an enemy invasion. Naval officers who studied the photographs, however, were positive that the forms which the photographs revealed were undersea craft. How they got there or what their mission might be, no one could guess. The only possible answer seemed to be that the submarines were rum-runners' craft. Government rum chasers sped up the Hudson to investigate, but when they reached the spot indicated on the photograph, the undersea forms had vanished without a trace.

NEARLY every sky photographer could tell you of hair-raising experiences through which he has passed. R. A. Smith, a veteran at the game, has had more than his share of narrow escapes. Two years ago, for instance, while mapping a drainage district in Florida, he and his pilot, E. P. Lott, were forced down by a

(Continued on page 104)

TISHY

Because they tagged him with that name, he made a tragic blunder—How he redeemed himself nobly in the hiss of icy seas

By CAPTAIN DINGLE

Illustrated by Anton Otto Fischer



Tishy knew where to go. Snug in the lee of the engine room casing he found two deck chairs side by side. The girl sat up straight, and her face lighted

THREE seemed no good reason for giving Burton such a nickname. As he stood up there on the navigating bridge of the *Diadem* in the swirling snow, handling the great steamer with the art of genius, he looked very much of a man, in spite of his apparent lack of inches. All the passengers, and as many of the crew as could, watched in fascination the maneuvers of a lifeboat, battling with the long green seas in the bitter cold, midway between the *Diadem* and a partially dismasted windjammer from whose signal halyards flags snapped in the wind. The steamer was closing on the ship, to give the boat a short pull and make a lee for it.

The captain stood in the bridge wing, anxiously estimating distances; but he made no comment; he seemed confident in the chief officer's handling of his steamer. That was not misplaced confidence. Nobody called the chief officer "Tishy" on duty. Only in the less official atmosphere of the off duty hours did the other officers use that name. And Debron was responsible for it in the first place. Debron, who at that moment handled the lifeboat out there in the roaring cold seas with much the same sort of inspired skill as that with which the big steamer was handled.

Debron had been mate of the sailing ship in which he and Burton learned their profession together. Burton had been second mate. Both completed their apprenticeship and got their tickets at the same time; but Burton hadn't the same commanding physique as Debron; the bulkier man got the preference in that first test of fitness, and perhaps it was right that it should be so, for there were many occasions under the square rig when brawn and muscle counted for much in a pinch. There the two had remained pals. Debron always conceded superior brilliance to Burton. That was just. Burton secured his extra-master's certificate at the same time that Debron got his plain master's. But while together in the windjammer, Debron lorded it in physical superiority; always protective; always jumping in to take the heavy work when any other second mate would have fought for it as a right.

There it was that "Tishy" was born. Decent, honest, stolid Debron thought he did a wonderful bit of creative work in nick-

naming his clum "Tishy." And Burton endured it, rather than fight a gleeful third mate and a half deckful of ribald 'prentices, some of whom were, at sixteen, bigger men than he was at twenty-two. But here, in the *Diadem*, it was different. He was entitled to some dignity. Debron was only second mate now; Burton's higher grade certificate had given him the lead; but Debron had introduced Tishy to the mess, and of course the name stuck. That sort of name will. Therefore, standing by the engine-room telegraph, when all his mind should be centered upon his handling of the big steamer, Burton found bitterness flooding his soul because Debron, the author of so many little unintentional injuries, had usurped the place in that boat which rightfully belonged to him.

"**L**EAD Debron take the boat. He's a huskier man than you." That's what the captain had said. He had softened it a bit by making some remark about Burton's ability to handle the steamer; but it had not fooled Burton. He watched the sailing ship and the boat as if he wished the one would run over the other, and with luck sink both.

What had seemed likely to be a thrilling boat rescue, and a nice bit of salvage to follow, developed into a simple towing job. It was annoying. That big steamer cost money to run; days of delay meant black looks from owners. Yet a man could not leave that old windjammer skipper and his people in the lurch. Rather, his stubbornness in sticking by his ship merited praise. And so the *Diadem's* master agreed. The passengers cheered when Debron took a line across, by which a towline was hauled aboard; they cheered Debron himself when he came over the side from the boat. And when the steamer straightened out on her course, dragging the helpless sailing ship astern of her, they praised the captain for the splendid manner in which he had handled the job.

Tishy ate bitter bread on the bridge until his watch was up, and then he went to his room by devious ways of ladder and alleyway in order to avoid meeting people. Never before had he realized the full depth of the rut he had fallen into. In the matter of his profession he was bound to go ahead. He was a keen,



Debron headed the boat straight for the windjammer, a stripped and dismasted waif of the seas. The old skipper gesticulated and bawled at him

clever officer, a born steamship man, a navigational wizard. He absorbed the modern gadgets of navigation, Gyro compass, electric sounding machine, radio bearings, and the rest, far more easily than poor Debron had absorbed the simpler rules of the sheer essentials. And both his captain and his owners knew his worth. But when he recalled the faces among the passengers, to avoid which he sneaked below, he gave way to a little exhibition of rage which might have amazed steady-going Debron had he been privileged to see it.

Of all the passengers he knew, scarcely one regarded him as anything more than a pleasant, courteous officer who shone when a dance was afoot, who always looked dapper and smart, who, no doubt, was placed there just for the purpose of being, looking, and doing just that. Debron might often be found in the center of a crowd of men, telling men's yarns, laughing very manfully. Debron might be found before dinner drinking a man-size cocktail with the smoking room habitues. Tishy—he even thought of himself by that hated name in his wrath—Tishy was always sought after at tea time, by the ladies. In the evening, he might be asked into the music salon to sing. Not one, man or woman, of all those people, but doubtless looked upon Debron as a pillar of strength set there for their safe seafaring; and looked upon Tishy as a pretty little fellow kindly put aboard by thoughtful owners to amuse their idle hours.

TI SHY flung his cap into the bunk, and grabbed a cigarette so savagely that it broke into three bits. He hurled the bits at the cap, and swore. That is, he began to swear, caught sight of a book half hidden beneath the cap, and caught himself up sharply with bitten lips. He had been wrong in his estimate of the passengers. There was one who looked up to him; who asked him questions about the sea, and ships, and the stars; who sat as if entranced while he spoke; who—

He grabbed the book, and swung on his cap, darting back on deck by the saloon companionway as if bound upon some very

congenial errand indeed. The decks were deserted. Evening was at hand; the cold was piercing; snow still dusted the air, almost blotting out the wallowing old windjammer at the end of the long towline. There were voices in the smoking room. The social hall was aglitter with lights, atinkle with tea equipage. Tishy knew where to go. Snug in the lee of the engine-room casing he found two deck chairs side by side. In one, swathed like a mummy in heavy rugs, a hawk-nosed old gentleman lay, with closed eyes, only his beak of a nose and eyelids showing through his wrappings. A teacup and saucer clattered to pieces on the deck beside the chair, and the occupant of the second chair began to unwind as Tishy appeared.

"Father! Why didn't you give it to me?" queried a girl's voice, with a trace of weary patience almost overstrained. Then: "Oh! You startled me, Mr. Burton!" in a much happier tone.

THE girl sat up straight, and her face lighted. It was easy to see that here was one person at least who thought pretty highly of Ned Burton. Blanche Torrey was small, and of the type that keeps its youth; when she smiled, she smiled from her curly black hair right down to her dainty toes, and whatever or whoever was near was the better and brighter for her smile. Perhaps that was why her ailing, bad-tempered father clung to her like an old man of the sea, rarely permitting her time to relax or take part in the amusements of the crowd.

"That's the fourth cup and saucer father's broken. He will not let me put it down, ever. Do you think they'll send us a bill?" she smiled. When she looked up into Burton's face like that, he forgot that he ever felt bitterness. He warmed through and through; and not the least of his warmth was directed at old Colonel Torrey for his selfish monopoly of his daughter's time and care. That was not a kindly warmth, though.

"I don't think you'll be punished very severely," he said. "They may possibly insist on serving the colonel's tea in a

tin mug. I came up to give you this," handing her the book. "This writer catches the real spirit of the sea as no other that I have read does. You'll find beauty in the one called 'Sea of Light.' "

THE colonel roused himself, and querulously wanted to be taken below to prepare for dinner. His invalidity seemed to have little effect upon his appetite. Burton folded up the rugs, and held the book while Blanche buttoned up the old man's coat, then opened the companionway door and watched the pair go below with mixed feelings warring within him. The steamer had only been six days at sea; he had never met Blanche Torrey before. He did not like old Torrey very much, but he did like Blanche. Liking was not the word. He was in love. And a glow warmed him to the toes when at length he closed the doors against the snowstorm, and turned to go back to his own quarters. Just then he cared but little, if at all, for the face the world showed him. Let men call him Tishy. What of it? Let Debron take the boat, get the credit. What of that? Debron never won a smile in his life like that which Blanche flashed back at Tishy Burton just before the door closed on the companionway.

Burton walked the length of the hurricane deck, past the smoking room. Voices, of course; warmth, light, and companionship of men. What did he care? Burton half stopped. A cocktail seemed entirely in tune with his spirit. Through the big round porthole he glimpsed the interior. There were all the habitues. Big men of the world. Enjoying their voyage. Forgetting landwise cares. And in their midst was Debron. They were listening with jovial eyes and keen attention to some yarn he was spinning, and when it was finished the smoking room rang with their merriment. The last fleeting glance Tishy Burton shot through the port glass showed him Debron in a circle of hearty back-whackers, aglow and agleam with the natural gratification of a man, not yet old, who receives the adulation of his fellows.

"Damned hero worshippers!" growled Tishy, bending his head against the storm and hurling himself along the alleyway to the seclusion of his room.

AS THE steamer dragged its unwieldy tow into the waters near the coast, her navigators began to look for sun or star to verify her position. For days the snow had blinded the skies. The steamer was sheathed in ice from amidships on the weather side to the bows on both sides. On the tow, only one man was ever visible. Aboard that stripped and dismasted waif of the seas, with her bare decks and lack of shelter, only a helmsman showed his nose outside. Seemingly with reason, too, for the wreckage was frozen into a solid lump of grotesque form: all of the old windjammer from broken jib boom to stump of foremast was solid ice. Her forecastle head, anchors, capstan, headstays and all, had nothing of shipshape left. Roaring through the seas after the powerful steamer, the old ship took sprays in sheets, and already she was down by the head through sheer weight of ice.

As the ships came within the anticipated range of the lightship marking their turning point, the captain was often on deck with his sextant. The second officer scarcely bothered to put his sextant back in the case as long as there was a chance of a star appearing. And the officers keeping watches were on the alert through the night, anxious to get a sight, for the dead-reckoning of the past few days was none too certain, with that lumbering tow astern, dragging the steamer back, hauling her to one side or the other as she

sheered wildly to the weight of the ice fastened about her head.

Tishy suffered many moods in those anxious days. When he could talk to Blanche Torrey, he felt as if the world was not only splendid, but that it actually belonged to him. At other times he was not so sure that he cared who the world belonged to. Why the devil did Debron want to plaster such a name as "Tishy" on a man? That was what Burton wondered. And how grown men could derive pleasure, or simple fun, out of calling a man by such a name absolutely beat him. But he felt bitter about it, nevertheless. He hated Debron very heartily that evening when the lightship ought to have shown up. Burton was talking with Blanche, telling her about stars, and navigation, and some things not particularly concerned with either of those studies when Debron came looking for him.

OH, TISHY, the Old Man wants a line of soundings," Debron said, then saw the girl, apologized with a grin, and added: "The electrical sounder is not working well, Mr. Burton. It gave a jump from three hundred to thirty just now."

Burton went about the job in sailorly fashion, taking a quartermaster along to the sounding machine, and ran his line in proper style; but he seethed inwardly because she had heard him called "Tishy." Debron again. Of course. Nobody but that big lout would think it funny.

During the night a star came out. Debron was on the bridge. Burton stayed up, too, for whatever he might feel personally toward Debron, he was instinctively eager to fix the steamer's position. Burton stood with his sextant just clear of the shelter of the bridge, patiently trying to hold a star in the field of his glass long enough to bring the image down to the hazy horizon. His line of soundings had puzzled him. There should have been more water. If he could catch a sight of that star—

"There's the light, Tishy!" Debron suddenly called softly from the bridge. "We're away up. It's almost abeam to port."

"Better call the captain if you feel uneasy," replied Tishy. He was not on watch anyhow; why should he concern himself with Debron's anxieties? He went ahead with his sextant,

jockeying the star down. He had not yet seen the light. Debron could see it up there on the higher bridge. As a matter of fact, Tishy was not at all sure that the lightship was in sight. So many young seamen, such for instance as Debron, who would never grow up except in powerful physique, often mistook a star, low on a hazy horizon, for an expected light. Judging by all the signs, soundings, and so forth, that lightship should not be in sight anywhere near the bearing Debron reported it on.

Debron on the bridge muttered to himself. He was a qualified officer, had a master's ticket, and would be chagrined if, after calling the master, he were found to be unduly anxious. If that were actually the lightship, why, then there was no need for anxiety, since the ship had made her point as expected, and all that was necessary was to get a four-point bearing for distance, enter it in the log, change course, and go ahead full of confidence. Debron, as senior second mate, was navigator; if he couldn't do that, he would hear something hot from the Old Man later on.

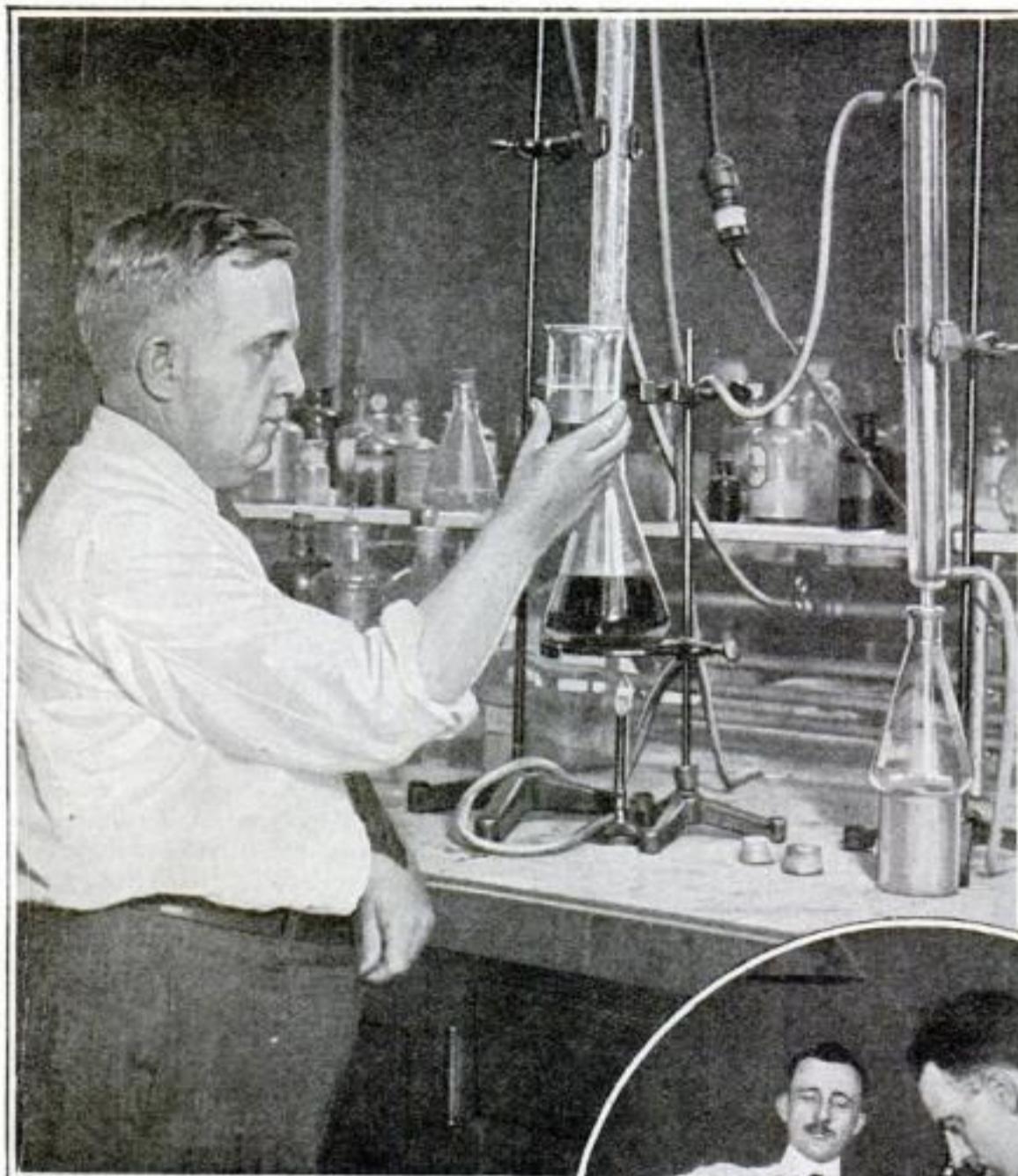
Tishy fiddled with his star. The horizon was uncertain. But there flashed across his glass the stab of the light, and he stopped fussing for a moment and got the light into an angle with the star. He held the contact for several minutes, and when he took the telescope from his eye, it was with a sharp gasp of wonder. Another sight, another contact, and a

(Continued on page 105)



Out there in the icy seas, swimming like an otter, with a heaving line snaking out after him, Tishy flogged the swirling water fiercely

The Truth about Poison Liquor



Dr. W. V. Linder, chemistry chief, U. S. Internal Revenue Bureau, working to discover a new alcohol denaturant that would be more effective and less harmful than wood alcohol.

OF LATE, Uncle Sam has been on trial before the bar of public opinion, charged with no less a crime than willful and premeditated murder.

The Government of the United States, and particularly the officials who enforce prohibition, stand accused of deliberately poisoning industrial alcohol and so injuring or killing those who unlawfully buy and drink the liquor concocted from it by bootleggers.

These startling accusations followed on the heels of reports indicating an appalling increase in liquor deaths in the last year. Heightened by the recent Government order doubling the amount of the poison, the reports aroused a furor of protest and controversy throughout the nation.

Among the protestants were highly responsible citizens, including educators, judges, journalists, statesmen and clergymen. Typical among them was Dr. Nicholas Murray Butler, president of Columbia University. "Murder!" he declared. "Just plain, unadulterated murder by our glorious paternal Government, is what I think of the deaths attributed to the consumption of liquor



Behind the scenes in the new chemical warfare: H. B. Gammell and Chief Chemist R. A. Edson testing seized hooch for wood alcohol in Government laboratories, New York. Most bootleg liquor today contains this poison.

manufactured from poison alcohol!"

So much has been said both for and against the new Government order that most of us have found it difficult to get through to the bare facts in the case. Just what is all the hue and cry about?

Briefly, the Federal Government, in order to supply industry freely with much-needed grain alcohol and at the same time make that alcohol unfit to drink, requires it to be denatured with wood alcohol, a violent poison. But since the alcohol so denatured can be obtained readily, large quantities of it pass into the hands of bootleggers. They, in turn,

How Uncle Sam Wages Bitter Chemical War to Put Industrial Alcohol Beyond the Bootleggers' Reach

By

FREDERIC DAMRAU, M. D.

attempt to "re-nature" it by re-distilling or "cooking" it. But it is chemically impossible to remove from grain alcohol all of the wood alcohol used in the denaturing process.

The result is that much of the alcohol passed on to the public in bootleg gin, whiskey and other drinks, is certain to contain quantities of the poisonous denaturant. Government officials say that of 90,000,000 gallons of industrial alcohol produced every year under Federal supervision, at least 10,000,000 gallons find their way into bootleg liquor. This, when other ingredients are added, will make about a quart of liquor for every man, woman and child in the country. In fact, most of the bootleg liquor sold today has its source in industrial alcohol denatured with poison.

OUT of this situation have arisen the bitter complaints that Uncle Sam is trying to poison those who will not obey the prohibition law. The accusers, on the one hand, charge that the Government, knowing full well that some of the poisoned liquor will be consumed unlawfully, stands responsible for deaths caused by drinking it. Some have gone so far as to accuse the authorities of seeking to terrorize the public into abstinence.

On the other hand, defenders of the Government's course contend that the bootleggers, and not the Government, are the real murderers. They argue, too, that the victims of poisoned liquor are really suicides; that the Government cannot be expected to protect a citizen from his own folly; that, anyway, most deaths are due to excessive drinking rather than to the poison; and, finally, that most of the fuss about poisoned liquor is, after all, anti-prohibition propaganda.

There you have the two sides of the argument. Strangely enough, though,

neither has emphasized the unanswerable scientific fact about the whole business. It is this: The reason Uncle Sam requires the use of wood alcohol as a denaturant, is that chemistry thus far has been unable to discover a less harmful way of preventing the conversion of industrial alcohol into a beverage fit to drink.

Wood alcohol has proved to be the only known denaturant which bootleggers can't "cook" entirely away. This is because it boils at approximately the same temperature as the pure grain alcohol with which it is mixed. Bootleggers' chemists may be able to distill it off up to a certain point; but beyond that point the grain alcohol boils away with it.

THIS is about what happens: Grain (ethyl) alcohol boils at seventy-eight degrees centigrade; wood (methyl) alcohol at sixty-five degrees. When the bootlegger puts denatured alcohol into a still and raises the temperature to sixty-five degrees, the wood alcohol will begin to boil, evaporate and pass into the condenser; but not all of it will evaporate until a much higher temperature is reached. Even if he raises the temperature to the boiling point of grain alcohol, the evaporation of the wood alcohol will not be complete. Before seventy-eight degrees is reached, the grain alcohol will begin to evaporate along with the wood alcohol. The two never can be entirely separated. The double dose of wood alcohol added by Government regulation at the beginning of the year was intended to make industrial alcohol not twice as poisonous, but half as likely to be utilized



for illicit purposes. In other words, plainly, the alcohol is made poisonous not with the idea of killing drinkers, but because the only known unremovable denaturant happens to be poisonous.

Long before prohibition—in 1906, to be exact—denatured alcohol was made available to American industry. A half century before that it had been introduced in Europe. Its original purpose was to avoid the high tax imposed on all alcoholic beverages. The denaturing process placed tax-free in the hands of manufacturers and chemists one of the two most useful chemical solvents known—in

quantities and at a cost that made it commercially practicable.

Out of its use have grown some of our greatest industries, as, for example, the manufacture of explosives, artificial silks, products such as celluloid, perfumes, extracts, anti-freeze mixtures, and so on. Today it is indispensable to some 200 industries, and wonderful new uses for it are being found continually. It is vital to chemical progress.

As long as there was plenty of potable liquor to be obtained, no one ever thought of drinking denatured alcohol. But when prohibition came along, and later when smuggled liquor became harder and harder to obtain, bootleggers turned to the industrial product. And then the trouble began. There developed a keen chemical warfare between the chemists of the bootleggers on the one hand, and the Government chemists on the other. The former were bent on "cooking" out the denaturants; the latter were equally intent on preventing them from doing so.

NOW, many different ingredients have been employed in many different formulae—about sixty in all—for denaturing alcohol. The Government divides the product into two general classes: completely denatured alcohol and specially denatured alcohol. For the former, wood alcohol is used almost entirely. For the latter, the method is varied according to the special requirements of the industry in which the alcohol is to be used. For example, brucine, a poison closely related to strychnine, has been largely used as the denaturant for making "beauty" preparations and barbers' supplies. Nicotine has been put into the alcohol used in the tobacco industry. Gasoline, benzol and bay oil are other denaturants.

The specially denatured

alcohols fell one by one before the ingenuity of the bootleggers' chemists. They found a way to remove brucine by repeatedly distilling the alcohol. They did the same thing with nicotine and other denaturants. So successful were they, in fact, that the Government at last was compelled to tighten the restrictions on the sale of specially denatured alcohol, and since then it has been sold only by permit under heavy bonds.

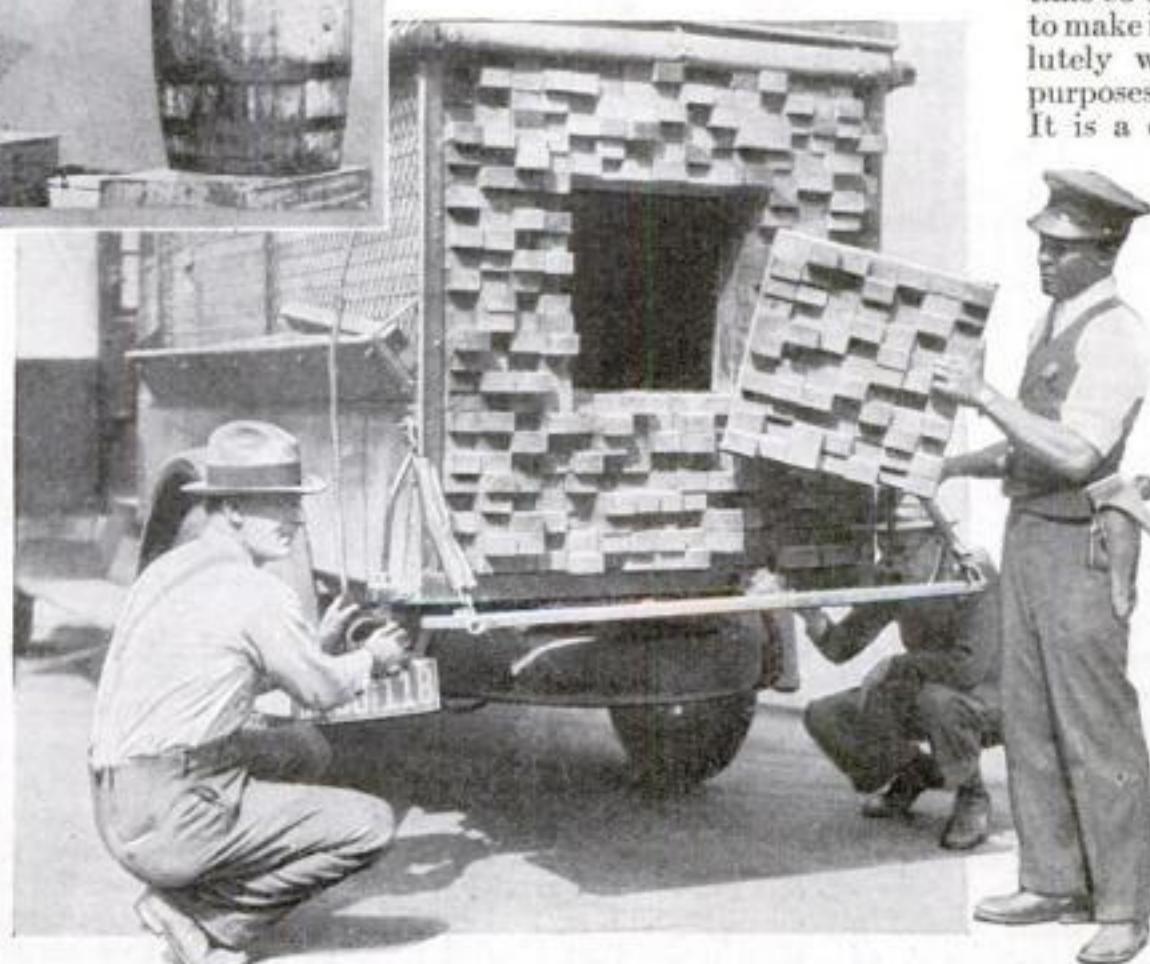
This has left completely denatured alcohol the only alcohol easily available. There are no restrictions on its sale, for no amount of chemical skill can remove all the wood alcohol from it and make it fit to drink. It is sold everywhere, in any paint store or public garage, no questions asked.

Wood alcohol may cause violent illness, blindness or death after the consumption of a surprisingly small amount. In mild cases of wood alcohol poisoning, the mental processes are benumbed and clouded, there is marked loss of memory accompanied by extreme dizziness, which may be followed by death. Highly poisonous doses produce overwhelming prostration. The patient sinks rapidly into coma, and death may come within twenty-four hours, or may be delayed as long as a week.

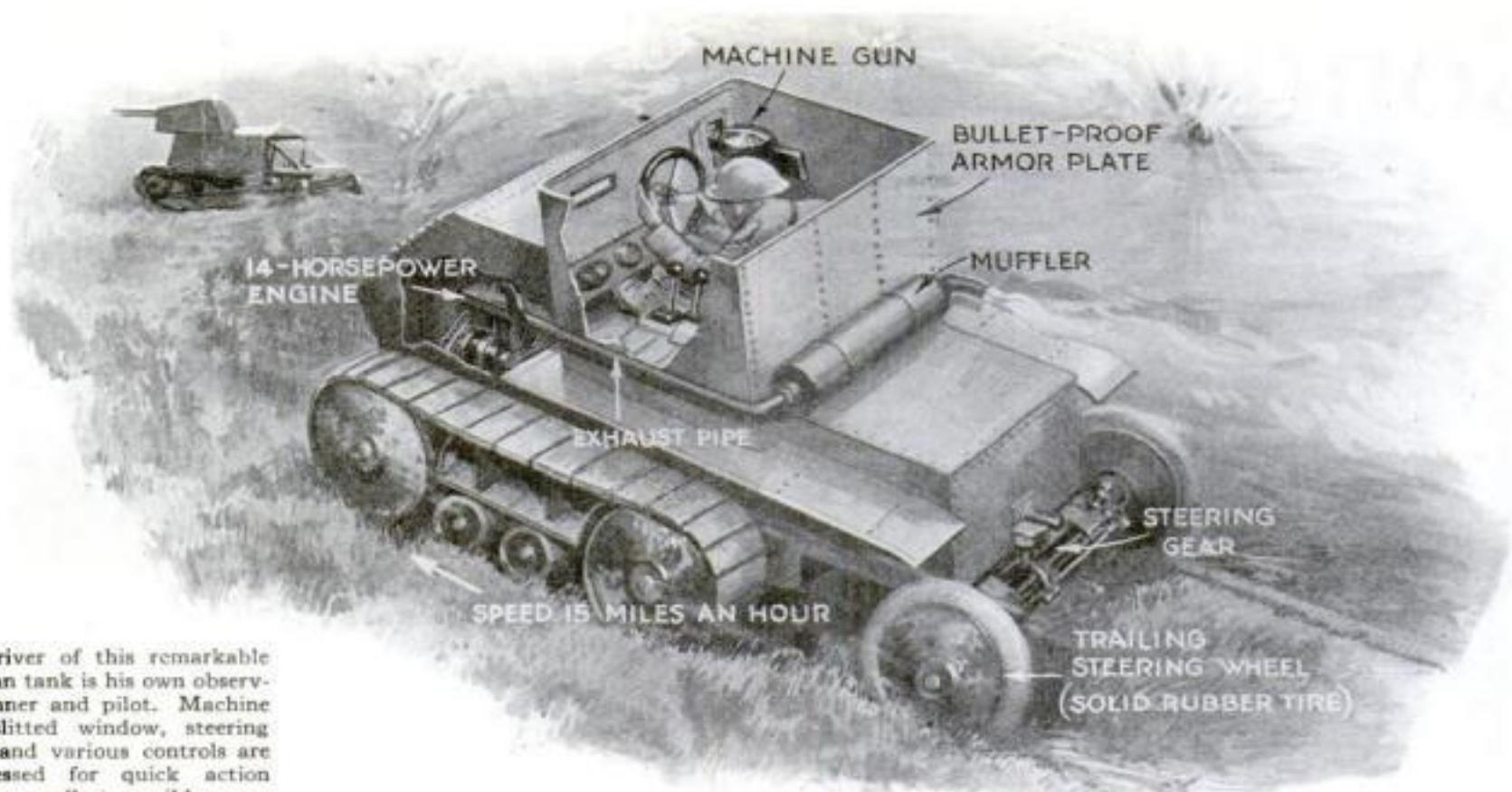
WOOD alcohol, moreover, is intensely poisonous to the optic nerves. Permanent blindness may result from a single drink. Under the new governmental order, completely denatured alcohol will contain four percent of wood alcohol, instead of two percent as formerly. Also it contains small percentages of kerosene and pyridine to make it still more unpotable.

Meantime, Government chemists are working untiringly to discover a new and more effective denaturant—one so obnoxious to taste and smell, and at the same time so difficult to remove, as to make industrial alcohol absolutely worthless for beverage purposes and therefore safe. It is a difficult problem, one which has long baffled chemists.

As this is written, however, reports from Washington indicate that a solution may be in sight. J. M. Doran, head chemist of the Prohibition Unit, recently announced the development of certain evil-smelling and bad-tasting oil compounds which, combined with wood alcohol, would advertise themselves like a bad egg in an omelet, and banish forever any desire to consume the mixture. It is impossible by any known method, he says, to rid the alcohol of these oils.



What appeared to be an innocent truckload of lumber turned out to be a bootlegger's ingenious device to transport hooch, when the odor of a broken bottle betrayed this vehicle to Los Angeles prohibition agents. Seventy cases of liquor were taken from the interior, which is entered by a trapdoor of board ends. Above: Typical still (50-gallon capacity) with which bootleggers' chemists try to "cook" the wood alcohol out of industrial alcohol. Federal prohibition officers capture as many as 170,000 of these in a single year



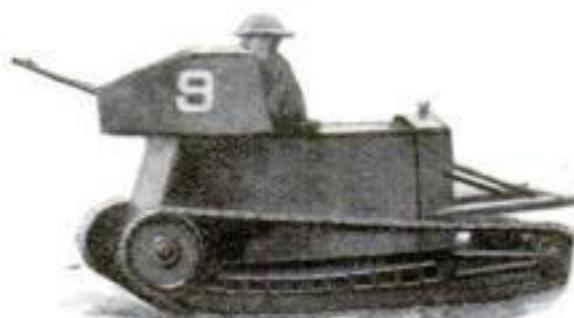
The driver of this remarkable one-man tank is his own observer, gunner and pilot. Machine gun, slotted window, steering wheel and various controls are compressed for quick action into the smallest possible space

Amazing New Engines of War

One-man tanks give artillery new mobility, while huge monsters haul guns, lead attack, or belch poison gas

ARMR-CLAD scooters dashing across a battlefield, spitting leaden death from protruding gun barrels—steel juggernauts that belch clouds of lethal fumes—will these land craft decide tomorrow's battles? Latest of peace-time inventions, the new tanks are ready to play their part should war again grip the world.

When premiers of the British dominions assembled recently at Camberley, England, they viewed a startling display of the latest war machines in action. Fleet one-man tanks, motors roaring, caterpillars whirring, raced about like swarms of monster ants. Bulkier craft careened over the pitted field at twenty miles an hour, hauling huge guns. An experiment in the last war, the tank of



The gunner of a speedy "whippet" tank crouches behind a revolving turret

the future, illustrated by these machines, may strike terror in whole armies.

Behind the single machine gun of the one-man "whippet" tank pictured in the center of the page, one of the new British inventions, the gunner crouches as he charges against the enemy. A battalion

of these speedy machines might overwhelm an army on foot. Another novel one-man machine, sketched above, adds a pair of rubber-tired steering wheels at the rear. It, too, is a fast craft.

From Warsaw, Poland, comes news of a tank recently tried out that looses poison gas from grisly steel cylinders slung on its roof. It is pictured at the left, below. Funnel-shaped projectors release a flood of deadly fumes. Again, battleships on caterpillar treads, monster tanks with gun-spiked turrets, cruise overland against hostile armies.

Only a shell's direct hit can harm these bullet-proof machines. It takes time to aim a big gun. The new tanks, by virtue of their speed, are somewhere else by the time enemy gunners have found the range.



Impervious to bullets, this latest Polish war machine belches poison gas in the enemy's midst. Its odd-shaped keel tramples obstructions



Wheels speed this battle craft along transport roads. A lever lifts them up and drops the craft on its caterpillar tread for cross-country cruises

Conquerors of the North

Stories of Wonderful Dogs with Hearts of Steel, and of Wild Races with Death across Arctic Snows



By
Jack O'Donnell

BOBBY BROWN, beloved Alaskan musher, prospector and dog racer, was dying. A buzz saw had severed one leg above the ankle and had thrown him violently against a piece of shafting, breaking the other leg and causing internal injuries. There wasn't a doctor in Dime Creek, where the accident happened. The nearest surgeon was at Candle, fifty-eight miles away.

Between Dime Creek and Candle lay a desolate, wind-swept, snowbound stretch of wild Alaskan country. The thermometer registered thirty below. Night was falling.

Bobby Brown's friends were in despair. Tenderly but crudely, they attempted to stop the ebb of his lifeblood and ease his pains. But only a surgeon could save or prolong his life.

Then came the electrifying news that Leonhard Seppala, king of the Arctic trails, was near by with his team of Siberian sled dogs—the same team that had wrested the dog-racing crown from the head of "Scoty" Allain—the fastest team in the North.

INSTANTLY, hope for Bobby Brown flamed in the hearts of the men of Dime Creek. Seppala meant speed, medical assistance, perhaps life. If anybody could run a victorious race with Death, Seppala was the man—Seppala and his great leader, Togo, and his other fleet-footed Siberian dogs.

Summoning Seppala, the miners tenderly lifted Brown to an improvised cot and placed him on the great musher's sled. Although he was in great pain, Brown looked up into Seppala's eyes and

Leonhard Seppala, who Breeds and Races the Fastest Teams of the North, Tells of His Amazing Adventures

smiled—a brave gesture of confidence. The next minute Seppala cried, "Mush!" Togo and his fellows sprang into action and, while the group of prospectors and miners of Dime Creek waved a silent Godspeed, the sled moved off.

For seven and a half hours Seppala drove his dogs through a blinding, sting-

of his passenger, to Togo, his leader. And Togo, aware of the trust, bent his head to the blizzard and inspired his fellows by his bravery, his stamina and his intelligence.

It was almost ten o'clock when Seppala sighted the lights of Candle. Half after the hour the errand of mercy ended—at the hospital.

Bobby Brown, still conscious but weakened by loss of blood, smiled his gratitude to Seppala—and Togo—as he was lifted and taken to the operating table. Seppala had won a temporary victory, at least, over death, for, despite the fact that Bobby Brown died two days later, the stricken man lived long enough to see members of his family.

That race against death, in the face of fearful obstacles, is talked of whenever Alaskans get together. Seppala himself makes light of it, just as he does of his gigantic feat of covering 340 miles in the historic antitoxin race to Nome in the winter of 1925.

"IT WAS the only thing I could do for a good friend," he told me in New York recently. "If anyone deserves credit, it is Togo, my lead dog. After all, a musher is only as good as his dogs. If Togo or the other nineteen Siberians in that team had failed, I would have failed and Bobby Brown would have died on the trail."

"Up there"—meaning in the Arctic regions—"that sort of errand is part of our everyday lives. We make no particular fuss about bravery. To us in Alaska the antitoxin drive, for instance, was nothing to get excited about. A number of persons in Nome were suffering from diphtheria.



Over the frozen wastes of the North race these teams of swift-footed huskies—bearing mails, passengers, messages of life and death. Capable of tremendous speed against fearful odds; fearless as their timber wolf ancestors. Photo above: Seppala's lead dog, Togo. On the lead dog's courage, intelligence and power of leadership depends the behavior of the entire team

ing blizzard, neither man nor dog giving thought to hunger or thirst. Over fifty-eight miles of snow and ice covered trails, the dreaded spear ice cutting into their bellies, the twenty dogs mushed onward. When inky blackness settled over the trail, Seppala trusted his life, and that

meaning in the Arctic regions—"that sort of errand is part of our everyday lives. We make no particular fuss about bravery. To us in Alaska the antitoxin drive, for instance, was nothing to get excited about. A number of persons in Nome were suffering from diphtheria.

The doctors needed antitoxin. There wasn't any of the serum in town. There were 300,000 units of it at Nenana. What was there to do but go to Nenana and get it? Nothing! So it was done."

"So it was done."

The phrase aptly expresses the attitude of these men of the North toward their daily life, whether that life be devoted to mining, prospecting, carrying the mail over wind-swept trails, racing the dog teams, or establishing a town on a new gold field.

Invariably the dogs are important factors. When, in 1896, Alaska was the Mecca of thousands of gold-hungry adventurers, the civilized world discovered that in the North existed a breed of dogs of marvelous stamina, speed, and courage. These were the native Alaskan dogs called Malamutes or huskies, strong, redoubtable canines sired by wild dogs and timber wolves. Because railroads and other means of transporting men and supplies over the snow-covered wastes were unknown, these dogs were pressed into service. Throughout the length and breadth of that land rang the stentorian command "Mush!" a corruption of the French word *marchons*, the cry of the early French voyageurs to their dogs.

WHEN dog racing became the major sport in Alaska, mushers like Seppala, "Scotty" Allan, "Fox" Ramsay and "Iron Man" Johnson turned their attention to the improving of the breed of dogs.

Ramsay, an English remittance man, imported Siberian sled dogs and raced them with surprising success. Seppala followed suit and today the Siberian sled dog is considered the last thing in racing animals. He is especially desirable in long hauls, being tireless, courageous, and endowed with great strength.

Dog racing, however, is not the chief reason for improving the breed of sled dogs. Until Alaska is covered with a network of railroads, the dog musher and his dogs will be indispensable in transporting passengers, mail and supplies.

Being highly intelligent animals, the improved breed of sled dog is easily trained. Kindness, firmness, and appreciation are the three essentials. Once a master tells a dog to do a certain thing, he must insist upon obedience until such time as the dog obeys.

In order to obviate impulsiveness and instill a spirit of stoicism into the beasts, the dogs are trained to await their meals with a minimum of barking, and to eat their daily ration without that avid voraciousness that characterizes most carnivorous animals.



"King of the Arctic Trails" Leonhard Seppala was known from end to end of Alaska long before he won world-wide fame as hero of the historic antitoxin race to Nome

Seppala's own astounding control over his dogs was the subject of amazed comment following his recent spectacular victory in the second annual point-to-point race of the New England Dog Club. One racer even attributed it to a kind of hypnotism. "He doesn't drive his dogs—he just 'clucks' to them and they lay into their collars harder than I've ever seen dogs do it before. Something comes out of him and goes into those dogs with that clucking!"

Seppala says there are thrills aplenty in the musher's life, but they come unexpectedly and almost invariably in the absence of an audience.

There was, for instance, the day he became lost in a blizzard during the 1914

All-Alaska Sweepstakes, the dog-racing classic of the North.

Seppala ran into the blizzard about fifty miles from Nome on the way to Candle. He was on a new trail, and the dog team, led by Suggen, sire of the now famous Togo, was making fair progress despite the high wind, snowdrifts and bitter cold. In a lull of the storm the great Norwegian musher realized he was lost.

"But I knew that if I headed due North I'd find a trail," he told me, "so I tried to steer in that direction. Suggen, however, kept trying to lead southwest. Somehow I did not trust the dog's instinct, and kept him to the northern course. Presently (Continued on page 134)



Winners all! Seppala and his Siberians, each a thoroughbred of the North. Their owner's most recent victory was the New England sled dog derby



Members of the Aerial Experiment Association, 1908: left to right, "Casey" Baldwin; Selfridge, who designed the first plane flown by the group; Glenn Curtiss; Bell, inventor of the telephone; McCurdy, just getting around after a crash; and, as guest, Augustus Post

Glenn Curtiss—Air Pilot No. 1

Impressions and Reminiscences of Stirring Days of Experiment and Achievement That Changed the World

By FRANK PARKER STOCKBRIDGE

"I DON'T remember when or how I first heard that a couple of young men named Wright had actually flown a heavier-than-air machine," said Glenn Curtiss in response to a question I put to him as we chatted one day in his Florida home. "Perhaps Captain Baldwin and I discussed it after the news of their experimental flights at Kitty Hawk had appeared in the newspapers; but if we did, it didn't make a lasting impression on me. We weren't thinking of heavier-than-air machines then; all of our interests were centered in the dirigible. It is quite likely that I was skeptical, like almost everybody else."

As a matter of fact, there was a general and quite fixed belief twenty years ago that man would never fly in a machine which did not have some sort of a balloon attached to it. That view was shared by the United States Patent Office, which did grant several patents on flying machines before the Wrights proved that the world was wrong in its opinion, but they all had some kind of a lifting device. Mr. Curtiss remembers seeing the drawings of one of these inventions. It was provided with a harness to which were attached a dozen or more live eagles! That was a

sample of what most people thought of when they talked of flying machines.

If Glenn Curtiss had any other thoughts on the subject of airplanes they probably were to the effect, he says, that Professor Langley's unsuccessful attempt in 1903 to make his "aerodrome" fly was proof that nobody would ever fly in a machine which did not have inherent buoyancy. The failure of "Langley's folly," as the machine was called in the newspapers, had brought unlimited ridicule. It seemed, in the minds of most people, to settle the question of the airplane. The dirigible was the thing. And Captain Thomas S. Baldwin and Curtiss

had built and navigated and delivered to the United States War Department the very first dirigible ever bought by any government. That was in 1905, about the time that the first news of the Wrights' flights began to leak out, although they had actually got their machine into the air on December 17, 1903.

"I HAVE never been much of a prophet," smiled Mr. Curtiss. "I could not foresee, then, that within three years I myself would win the first American prize for flight in a heavier-than-air flying machine; that within ten years I would even fly the Langley machine."

I reminded Mr. Curtiss of one of his attempts at prophecy, made in the early days of aviation, to the effect that a speed of 150 miles an hour was about the limit of practical speed for an airplane.

"It does sound foolish now, doesn't it, with speed of above three hundred miles an hour already accomplished?" he responded. "Still, I erred on the conservative side. I based that statement on the belief which I held in common with others who were experimenting with flight, that the maximum speed of the plane could never be more than double

MR. STOCKBRIDGE writes here another brilliant chapter, the second of a series, in his absorbing story of a great pioneer of American aviation. The installment is complete in itself, so you'll enjoy it even if you begin the series with this issue.

the minimum speed. Now, the minimum speed at which the plane will stay right side up is the landing speed. I couldn't imagine anybody landing a plane at a higher speed than seventy-five miles an hour. I thought I was stretching it a little at that; so I guessed at the possible speed in flight at 150 miles. Now, however, planes are built with a flight speed of above three times their landing speed, and can land at ninety miles an hour, giving 300 miles and more as the high speed in flight. I am not prepared to set any limits to the possibilities of the future."

"NOT even this?" I suggested, picking up from among a pile of photographs on his desk a drawing depicting the trans-Atlantic passenger airplane of the future. It showed, not a flying boat, but a flying ship—a regular three-decker, triple-winged, glass-enclosed, with a luxurious saloon on the upper deck, obviously accommodations for scores of passengers.

"Not even that," he came back promptly. Trans-Atlantic flight on regular schedules is bound to come. It might have come sooner but for the war. We were just getting ready for the first real attempt to fly across the ocean in 1914; then everything had to be subordinated to war needs—speed, maneuverability, altitude. The development of the airplane and the flying boat took a direction then from which it is only beginning to return. But it is as inevitable that trans-Atlantic flying service will be established as it was that trans-Atlantic telephony should be."

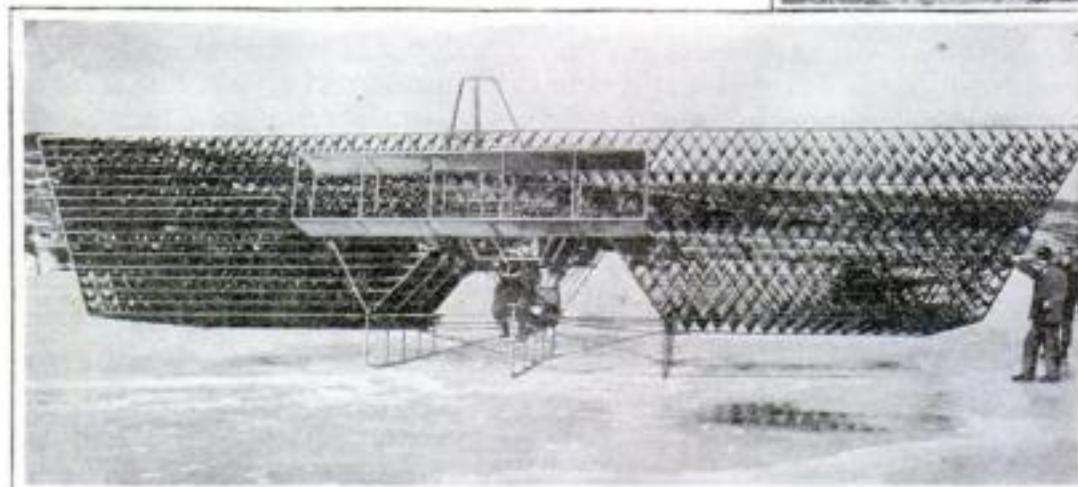
BACK in 1905, however, motorcycles with dirigibles "on the side" were still occupying Glenn Curtiss' attention. With Captain Baldwin he built dirigible after dirigible for exhibition purposes; personally he took his Curtiss motorcycles to all the important contests, and continued to win trophies and money prizes with unfailing regularity.

Other people were thinking about heavier-than-air flying machines, though. One of them was Prof. Alexander Graham Bell, inventor of the telephone. Another was a man in Detroit who had an original idea for a flying machine.

Curtiss can't remember even the man's

name now, but he wanted a motor built to fit a flying machine, of which he sent Curtiss a sketch. It was on the general lines of a length of stovepipe, being a cylinder within which he proposed to mount an engine and a propeller. He would get, he explained, a double effect; the suction of air at one end of the cylinder would tend to lift the apparatus from the ground, while the force of the expelled air at the other end would push the machine through the air. Curtiss "didn't think much of the idea," but the man's credit was good, so he undertook to build the engine.

It was the largest engine he had ever designed, eight cylinders, and while getting ready to build it, he wondered what an engine like that would do



Alexander Graham Bell's tetrahedral kite, above, an early flying experiment. It developed tremendous lifting power and actually carried a man aloft. His flying machine built on the same principle, however, at the left, failed to fly

on a motorcycle. He had won prizes in all the motorcycle contests he had entered, but he wanted to go faster than anybody had ever traveled before or was likely to travel. So, while building the engine for the stovepipe flying machine, he built a big motorcycle to fit it. He knew he had something which would go fast if it could be ridden.

The big motorcycle was finished late in 1906. Curtiss put it aboard a train and started with it for Ormond Beach, Florida, then the proving ground where automobiles and motorcycles were tested for

speed. The level, half-mile-wide beach stretching thirty miles

straight away, with its water-packed sand, is still one of the world's greatest speed courses, though the Indianapolis Speedway has displaced it as the official testing ground. There was a meet scheduled for January, 1907, and this offered a chance to try the big machine.

"I was on my way to Ormond for that race when I first met Professor Bell," says Mr. Curtiss of this trip. "Interest in flying was growing, and the Aero Club of America had arranged the first Aeronautical Exhibition, in an armory in New York City. A good deal of interest had been aroused by the announcement that the Wright brothers would make an exhibit, and so they did; but their exhibit turned out to be the crank shaft from the engine of the plane in which they had made their first flights."

"**P**EOPLE who had expected them to show a complete airplane were disappointed, but they were right in not disclosing their invention. Their foreign patents were still pending. They might easily have forfeited their rights by showing at that time how their plane was controlled."

Professor Bell had ideas of his own about flying. He had watched Professor Langley's experiments closely from their beginning, and had been especially interested in the engine, designed by Charles M. Manly, with which the Langley machine had been equipped. That had been the lightest-weight gasoline engine ever built up to that time, weighing less than two pounds to the horsepower. But the Curtiss engines designed



The giant eight-cylinder motorcycle, driven by Curtiss himself, which, at Ormond Beach, Florida, in 1907, made a record for two-wheelers that still stands—a mile in 26 seconds

for use on dirigibles were more powerful, just about as light in proportion to their power; and, at the Aeronautical Exhibition, Glenn Curtiss found Professor Bell absorbed in the study of them.

"That was how Professor Bell and I met," Mr. Curtiss said, "and I found him an enthusiast on the subject of flight. We talked about the reported success of the Wrights, and about the gliders with which Octave Chanute had made numerous experiments with air currents in the sand dunes of Lake Michigan's southeastern coast. Professor Bell thought that Chanute, the Wrights and all the rest were wrong in trying to fly flat planes. Safety in flight, he assured me, was to be found in the development of the tetrahedral kite."

"The word 'tetrahedral' rather floored me, I guess. I'm sure I didn't know then that a tetrahedron is a form bounded by four triangular surfaces—in other words, a three-cornered pyramid; and Professor Bell had to explain it to me. He had been experimenting with kites made up of a great number of tetrahedral cells, two of the four sides of the tetrahedron being formed of silk like a pair of wings. The kites had flown with great success, at his summer home at Baddeck, Nova Scotia. He had even sent a man aloft on the kite string, and had made aerial photographs, the precursors of the airplane photographs so familiar today, with a camera attached to the tetrahedral kite.

"If he could build up a block of these tetrahedral cells in the right shape and size, and attach to the whole an engine of the right type and weight, he believed a machine would result which would rise by its own power, carrying a man. He thought the Curtiss engine was the thing he wanted."

AFTER talking with Curtiss awhile, Professor Bell concluded that the young engine expert might be useful in helping develop his idea. The upshot was that he invited Glenn Curtiss to visit him during the following summer, at his country place at Baddeck, to talk about flying, and Curtiss promptly accepted.

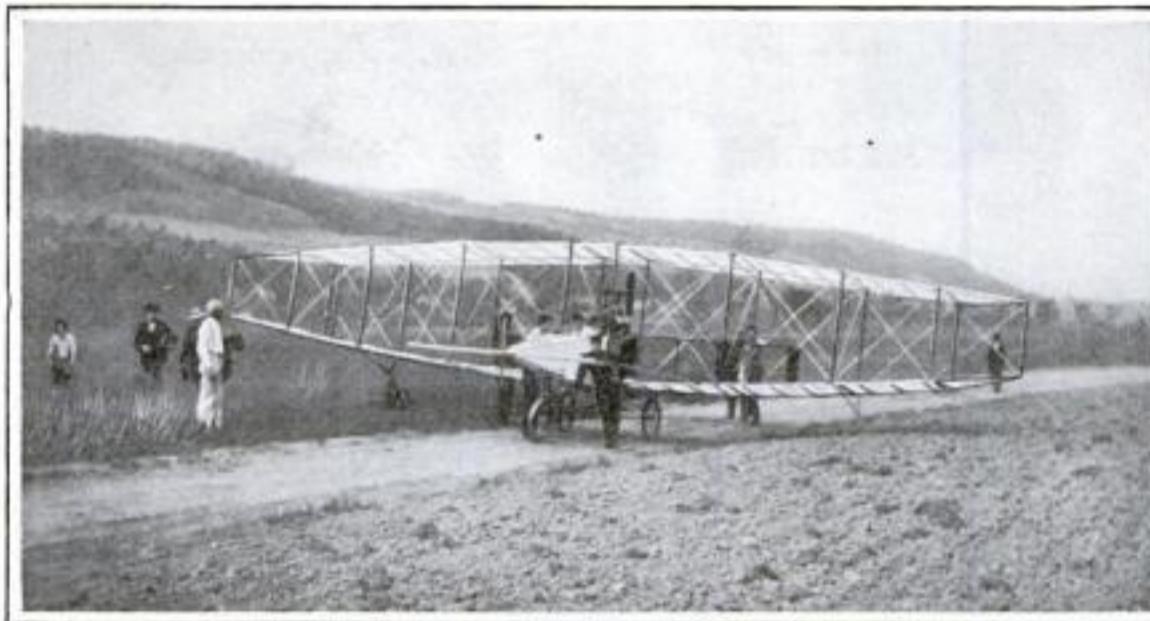
From that momentous meeting, at which Glenn Curtiss' thoughts were turned definitely toward artificial flight as distinguished from ballooning, the young man went to Florida and at Ormond Beach, on January 24, 1907, drove his eight-cylindered motorcycle faster



One of the gliders Curtiss built at Hammondsport, N. Y., early in 1908, for preliminary experiments in flight from the hillsides of Lake Keuka. Neither he nor the other members of the Aerial Experiment Association had ever been in a plane, and this was to give them the "feel" of being in the air

than any two-wheeled vehicle was ever driven before or since; faster, in fact, than anybody had ever traveled up to that time anywhere in the world!

A mile in twenty-six and two-fifths seconds was the amazing record which Glenn Curtiss set on that day. It is a record which still stands for motorcycles, although the giant machine, conforming



The *White Wing*, first airplane ever flown by Glenn Curtiss, on the day of its remarkable flight in May, 1908, when it rose in the air to real flying height, covered a distance of 1,017 feet, and landed undamaged in a plowed field. Its wings were cotton coated with varnish

to no accepted standard of design, was entered in a class by itself and the record is therefore not an "official" one under any of the rules governing motorcycle contests. This record stood for every class of land vehicle until 1920, when it was beaten by Tommy Milton in a racing automobile. But no two-wheeler has ever beaten the Curtiss record.

"How did it feel to go faster than you had ever gone before?" I asked him.

"I remember it satisfied my speed-craving," smiled Curtiss, "but I can't tell



Not so lucky as the *White Wing*, the *Red Wing*, above, first plane to be built by the Aerial Experiment Association, crashed on its trial flight

much else about that event. I wore no goggles and had no special costume except a helmet of my own make and a leather coat, but mounted the machine in my ordinary clothes, bent down over the handlebars and started off. I couldn't see anything but a streak of beach with a blur of waves on one side and a blur of sand hills on the other. Then the crowd was cheering, and that was all there was to it!"

After an interval of a few months spent in the motorcycle factory at Hammondsport—a corporation now, the G. H. Curtiss Manufacturing Company—followed the memorable summer of 1907, at Baddeck, with the three ardent young men who, with Curtiss and Professor Bell, formed the Aerial Experiment Association, out of which were to grow such epoch-making developments in the art of flying.

The others were two young Canadian engineers, F. W. Baldwin and J. A. D. McCurdy, and Lieutenant Thomas Selfridge of the United States Army. Baldwin had been assisting Professor Bell in the construction of his tetrahedral kites. He was not related to Captain Thomas Baldwin, associated with Curtiss in the development of the dirigible.

TO DISTINGUISH the two Baldwins, the nickname of "Casey," derived from the baseball poem, "Casey at the Bat," was attached to the younger, and he is still referred to by his former associates in

pioneer aviation as "Casey" Baldwin. McCurdy was the son of Professor Bell's photographer, who had done such excellent work in making aerial photographs from kites and was the inventor of the daylight developing outfit for roll film. Lieutenant Selfridge, a recent graduate of West Point and a young man of remarkable promise, had been detailed by the War Department to work with Professor Bell in the development of the flying machine. The word "aeroplane" was none too well established, and its Anglicized form of "airplane" had not come into use then; Professor Langley had called his machine an "aerodrome," and that was the term Professor Bell used for his tetrahedral device.

Nobody could foresee then that young Selfridge was to be the first man to lose his life in an airplane accident, killed in the crash of Orville Wright's machine on its first public (*Continued on page 113*)

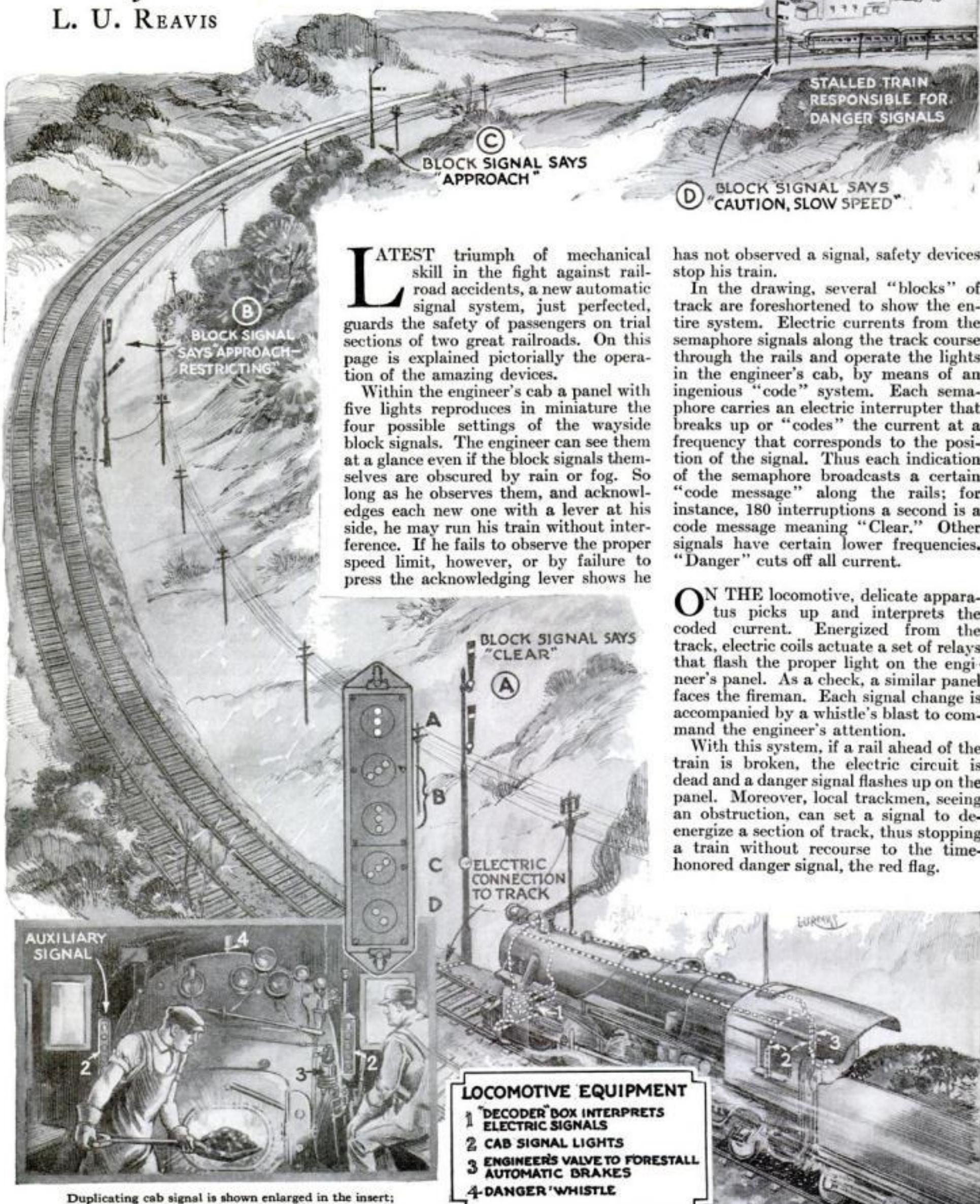
Electric Hands Prevent Wrecks

New Railway Safety Devices Work

When Engineer Fails

By

L. U. REAVIS

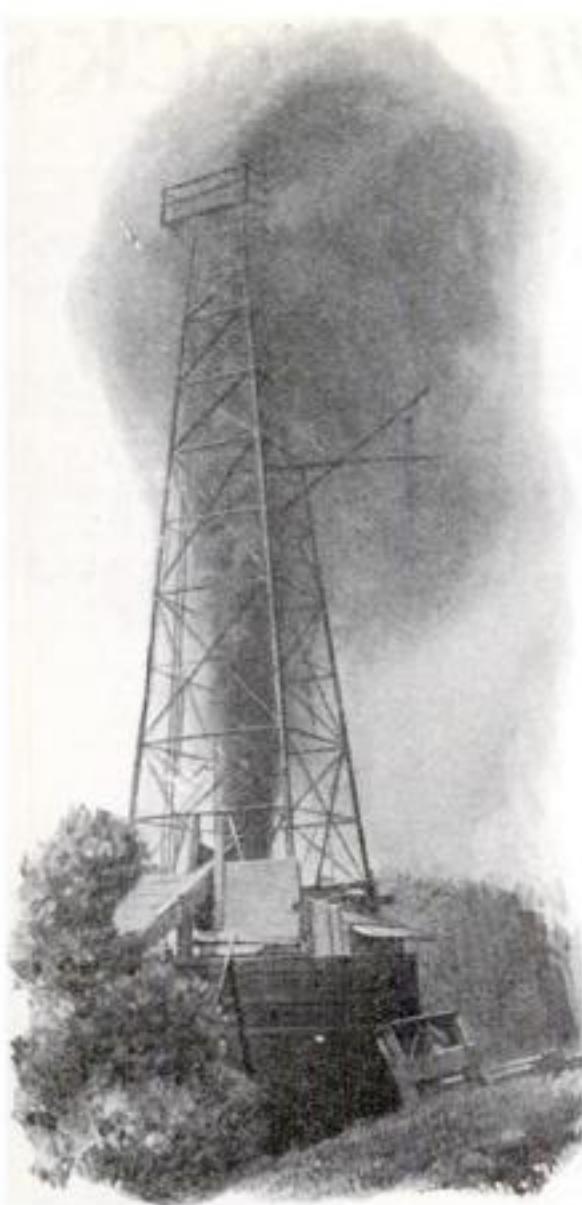


has not observed a signal, safety devices stop his train.

In the drawing, several "blocks" of track are foreshortened to show the entire system. Electric currents from the semaphore signals along the track course through the rails and operate the lights in the engineer's cab, by means of an ingenious "code" system. Each semaphore carries an electric interrupter that breaks up or "codes" the current at a frequency that corresponds to the position of the signal. Thus each indication of the semaphore broadcasts a certain "code message" along the rails; for instance, 180 interruptions a second is a code message meaning "Clear." Other signals have certain lower frequencies. "Danger" cuts off all current.

ON THE locomotive, delicate apparatus picks up and interprets the coded current. Energized from the track, electric coils actuate a set of relays that flash the proper light on the engineer's panel. As a check, a similar panel faces the fireman. Each signal change is accompanied by a whistle's blast to command the engineer's attention.

With this system, if a rail ahead of the train is broken, the electric circuit is dead and a danger signal flashes up on the panel. Moreover, local trackmen, seeing an obstruction, can set a signal to de-energize a section of track, thus stopping a train without recourse to the time-honored danger signal, the red flag.



An Oklahoma oil well a few seconds after a "shot" had transformed it from a dry hole into a steady-flowing gusher. "Shooting" a well requires amazing nerve and cool-headedness, for nitroglycerin, the agent used, is among the most powerful explosives known.

TWO autos were racing each other along a road in northern Oklahoma. From the opposite direction appeared another car, carrying a rack of odd-looking tin cylinders at its side. The racers came abreast of each other just as they passed the third machine, and though it swerved to avoid a collision, the inside car grazed the rack, sent the cylinders clanging to the ground, and raced on without a stop.

Probably the speeders never knew how great a risk they had taken. That third car was loaded with 120 quarts of nitroglycerin. Its driver, Willis Hill, was on his way to perform his regular professional service of "shooting" an oil well.

Hill got out of his car and replaced the tin cylinders, which were empty shells. Then he drove on, the brightly painted letters on his auto flashing warnings to those who cared to read: "DANGER—EXPLOSIVES."

If the racers had smashed into him and caused his cargo to explode, no one, later, would ever have known exactly what happened. A junkman seeking the wreckage of three autos might have been lucky to find as sizeable a fragment as a bolt!

Hill himself recalls one story of an accident in Kansas. A nitro-driver, on his way to Neodesha,

Men who Blast

How Nitroglycerin, Strangest of Deadly Explosives, Is Used to Release Vast Stores of Oil

By JESSE F. GELDERS

was hailed by a pedestrian who wanted a ride.

"You see what I'm hauling," said the driver. "I'm not allowed to pick anybody up."

"I'll take a chance," the stranger insisted, and finally had his way.

About a mile beyond Independence the man began to think differently, and asked to be let out. He started walking, and the car drove on, passing over a small hill. A moment after it was out of sight, the pedestrian heard a terrific explosion. When he ran to the summit, the car was gone. Signs of wreckage indicated its fate, but what had caused the blast remained a mystery. Only the hill between had protected the pedestrian.

A well-shooter's job is not for a nervous man. Hill's route to a well often leads him off the main highways on to dirt roads where the jolts seem to threaten instant disaster. But he always takes the bumps safely. It is a part of a well-shooter's work. Comparatively rough riding is made possible by his method of loading the car, performed with the same measured care which marks every phase of his job.

He lives by the rule, "Handle with care." He dies if he forgets it.

A few weeks ago Hill was shooting a well. When he reached his destination, the production superintendent immediately gave him the details of the situation. The hole was nearly 3,000 feet deep. It had penetrated into the sand in which oil was expected, and the borer had brought out slush with showings of oil. But it did not flow. So far, for all practical purposes, it was only a dry hole in the ground, dug at a cost of \$40,000.

NOT every oil well is shot. But hundreds of them are. Nobody has ever been to the bottom of one, to find out what happens when a charge of nitroglycerin is exploded in it, but the theory is that some petroleum-bearing sands are so dense or hard that they prevent the oil from flowing into the well. A blast shatters these crusts, lets the oil through, possibly opens new crevices to near-by pools.

Hill prepared to place a shot. He strung a wire cable from a windlass in his car over a pulley at the derrick. He filled one of the empty shells with nitroglycerin, from the cans in which it had been hauled.

With the loaded shell, he walked toward the well, picking his way cautiously over pipes and timbers. He moved with care, for one misstep might have meant disaster.

With the shell hooked to the wire cable, he lowered it into the well. Nearing the bottom, it entered a mixture of oil and water, standing many yards deep in the hole. That would act as "tamping" when the nitroglycerin was finally discharged beneath it, like a submarine torpedo. When the shell was deposited on the bottom, two more shells were lowered upon it.

Then Hill prepared a "squib," a much smaller shell, with a detonating cap and a long fuse, all encased in a slim, tin cylinder, a high-powered messenger which would say "Go!" to the charge a half mile underground. He lit the fuse and dropped the squib into the hole.

Its journey was a long one, the last lap through a column of water. It was timed to explode after a safe interval on top of the last shell.

Hill stood a short distance from the derrick, alert.

"There it goes!" he said at last.

To others, there was practically no sound, not a tremor of the



A historical photograph—America's first oil well, drilled by E. L. Drake at Oil Creek, Pa., in 1859. Compare this crude wooden structure with the modern frame above

for Liquid Gold

ground. But he was right. In a few moments there was a hissing at the mouth of the well, a sudden roar; and a black geyser spouted upward!

The drilling crew began to cheer. The roar grew fiercer, the stream shot higher, crashing against the top of the rig nearly a hundred feet above.

"It's cleaning itself, all right," commented Hill.

The accumulation of oil seepage and water which had acted as tamping was being hurled up. When this waste had been thrown off, two of the drilling crew went up to the derrick with crowbars and turned a valve, which sent the fresh oil pouring through a pipe into storage tanks. The oil well was flowing!

The production of that well measured 400 barrels a day after it had settled to a steady flow. The forty-thousand-dollar hole in the ground had been turned into a property worth about \$700,000.

Few men see so many fortunes made as a veteran well-shooter. Sometimes he sees the despair of failure, too, for when there's no oil in the ground, nitroglycerin can't put it there.

Willis Hill is a veteran, having shot wells for more than twenty years.

I STARTED back in Wood County, Ohio," he recalls, "but the well-shooting business began long before that—in Pennsylvania soon after the Civil War.

"Those were the days of the 'moonlighters.' A man named Roberts had some patents covering well-shooting, and everybody who wanted the work done had to pay him. The producers thought he was charging too much, and that's how the fight started. It was before my day, but I've heard some of the old-timers tell of it."

When Roberts learned that an owner had had a well shot without engaging him, he would hale the man to court and force him to pay for the use of the patents.

Then came the "moonlighters," well-shooters who did their work in secret. In the still of night their wagons rolled along the Pennsylvania roads, hauling nitroglycerin, and by the dim light of the moon they would



Willis Hill, veteran well shooter whose thrilling experiences probably won't tempt you to follow his dangerous footsteps! The slim cylinder is a "squib" used to detonate the nitroglycerin

engage Roberts to place a light shot. "We don't need much," he would say. "The formation is pretty shallow."

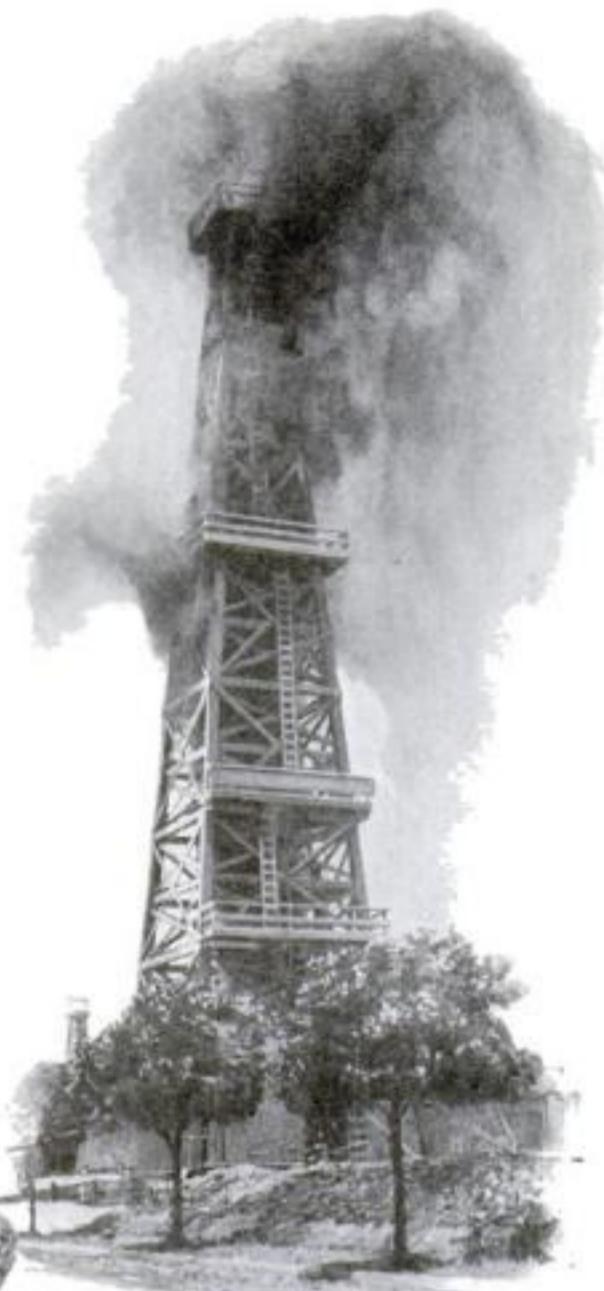
So Roberts' men would lower a small shell, ignorant that it rested on top of a much heavier charge, and when they fired their shell, the entire column was detonated! Sometimes the scheme was suspected, but Roberts was unable to put an end to this unlawful practice.

Right or wrong, moonlighting was re-

lower their shells and set them off.

But soon these jobs were discovered by the alert Roberts forces, and the producers again had to pay. Whereupon a more subtle plan was evolved.

The moonlighter would come with his nitroglycerin and shells, and put them into the well. Then, without detonating them, he would steal away. The owner would then send for Roberts. The latter's fees were fixed according to the amount of nitroglycerin used. The producer, with his own shells, or "sleepers," already at the bottom of the well, would



A "gasser." Drilling for oil, a daily flow of 35,000,000 cubic feet of gas was released in this oil well near Los Angeles, California

garded as a romantic and not unworthy pursuit. Today most of the oil fraternity look back upon it and chuckle. Some of the men who were moonlighters in those early days are still active in various oil field enterprises. One of them is a director of a bank influential in oil financing.

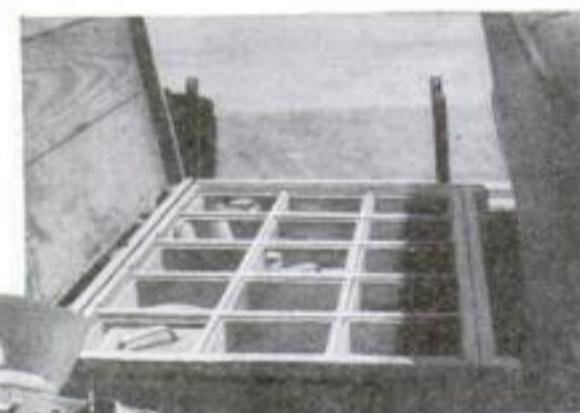
HILL is reticent on the subject of disaster and hazards in well-shooting, but a partial list of men who had been engaged in shooting oil wells, published ten years ago and including 147 names, showed that sixteen of those men—one out of every nine—had been killed by explosions. The little booklet's descriptions of the sixteen fatal

explosions are terse. There is the name of a victim, the date, and the location. Then it adds, "at magazine," or "with squib," or "with car." Usually that was all that was known.

"You can get some idea of the force of these explosions from what happened at one near Altoona, Kansas," Hill said. "A truckload blew up there and made buildings tremble. (Continued on page 125)



Ten quarts of liquid death. The "nitro" can and novel rubber "boot" it is packed in for safety



A car that usually has the road to itself. Willis Hill is shown here loading 150 quarts of nitroglycerin, packed in compartments as shown in the upper illustration, into his automobile

Now—Traffic Rules for Aircraft

Government Regulations Provide No Speed Limit, but Give Balloons Right-of-Way over Planes and Require License Numbers to Be Visible

DID you get your 1927 pilot's license? It's something new. Like the rules for auto drivers are the traffic rules for aircraft just issued for the first time by the Aeronautics Branch of the U. S. Department of Commerce.

Reading them, it is easy to imagine the day when the air will be thick with airplanes, and traffic officers may direct the streams of flyers from captive balloons. Now right-of-way and license numbers belong as much to the air as to the motor road, as set forth in the Government's new rules.

First rule of all, you must have a pilot's license—without this you cannot take the air, unless you would risk a \$500 fine. There may be as yet no "motor cops" of the air to blow a whistle and shout, "Pull over to that hill—let's see your license!" but it is well to carry on your person the certificate that proves you have passed an official pilot's examination.

ASIMPLE test is all that is required for a "private pilot's" license—one who flies for pleasure, not for pay. In figure 8's, you circle two pylons and make several landings. Then a written ex-

amination proves you know how an airplane engine works; that a plane in distress at night fires a succession of Very lights; that a seaplane alighted in a fog must use a foghorn. Your test is less severe than that for "industrial pilots," who carry commodities, or for "transport pilots," who carry paid passengers.

Now you may fly, but take care that you observe the "rules of the road." See that plane about to cross your path, just emerged from the white cloud bank on your right? You must wait to let him by; he has the right-of-way. A moment, and he is past; the "road" is clear. There is no speed limit. Half a mile be-

By H. C. DAVIS

low, the ground flits behind you as you speed along to the accompaniment of the roaring motor, drinking in the thrill of riding the air. Without warning, a plane

almost beneath you, is a field black with people and lined with parked cars. Don't go below a thousand feet; that's the safety limit for an open-air crowd. A balloon ascension is in progress; the balloonist has just left the ground, and is wobbling skyward in his spherical ship. Turn out as you approach him; the right-of-way is his.

A GRACEFUL landing ends your day's flight. Home again, there is one thing more you must do. In a log that you keep for the purpose, make a brief record of your flight. Every three months you will send a duplicate of this log to the Secretary of Commerce at Washington. It must contain, also, notes of any repairs you have made on your plane, of the engine's running time, and of the result of the inspection you are required to make before each flight. Thus the Secretary has at hand the condition of every licensed plane in the country.

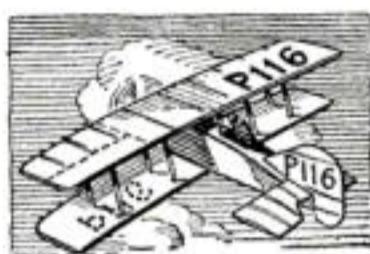
Like an automobile, every plane must now be registered and carry a license number. Huge figures painted on the wings and rudder serve as license plates and are visible from above or below and from either side. A letter prefix signifies the airplane's class.

"P" indicates a private craft, flown for pleasure; "C" designates a commercial plane, while aircraft owned by states or cities are marked with an "S." U. S. Government planes carry special letters, according to their department.

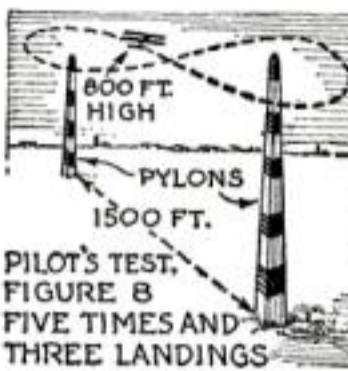
So an air pilot nowadays may lose his license because someone "took his number." If he violates any of the air traffic rules, his certificate may be suspended or taken away. Any passenger, or a Department of Commerce official, may demand to see his license at any time. These are a few of the new rules that are intended to make it safer to fly than to ride in an automobile.



INSPECTION BEFORE EACH FLIGHT



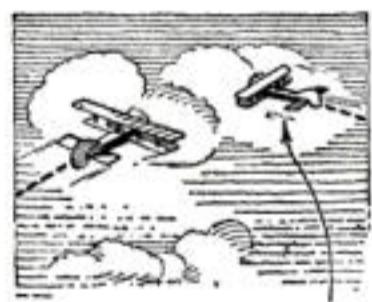
REGISTRATION NUMBER LETTER DESIGNATES CLASS OF PLANE



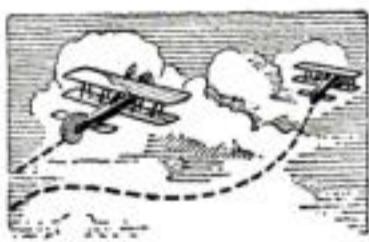
PILOT'S TEST, FIGURE 8 FIVE TIMES AND THREE LANDINGS



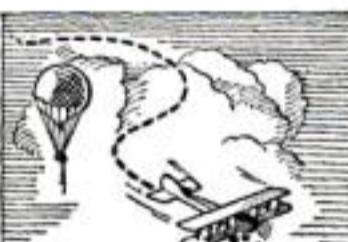
Airplane No. 1—first plane licensed by the U. S. Department of Commerce under the new sky traffic rules. The plane is for Government use, and "N" is the nationality mark of the United States as distinguished from other nations. The identification plate, which the two men are examining, must on all planes "be affixed to the fuselage in a prominent place."—The sketch at right, above, shows the "private pilot's" license test; other sketches, above and below, illustrate new traffic rules for airplane pilots



PLANE ON RIGHT~ HAS RIGHT-OF-WAY



PLANE OVERTAKING~ ANOTHER MUST PASS ON RIGHT AND KEEP 300 FT. AWAY

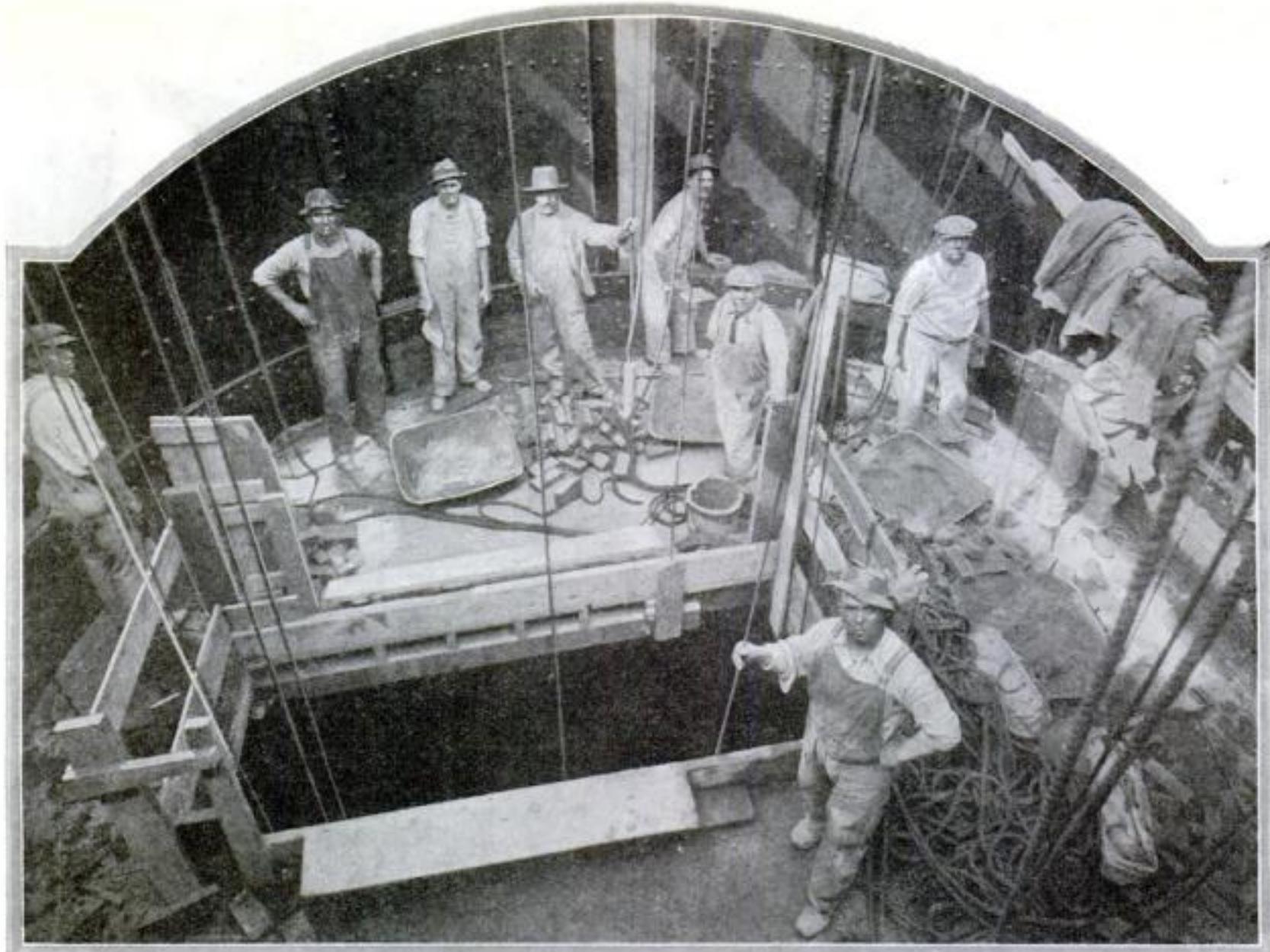


BALLOONS HAVE RIGHT-OF-WAY OVER PLANES. PLANES MUST TURN OUT

thunders straight toward you out of the mist ahead. Coolly you swerve to the right, and pass him.

Now you are overtaking another craft—the letters on his tail are easily visible. Pull over your rudder, sharply!—for you must give him plenty of room as you pass on his right—at least 300 feet, the regulation is. He might strike a treacherous air current and be hurled against you if you were near him. Throttle wide open, you go by, leaving a semicircle of exhaust smoke around his plane.

You decide to alter your course. You turn to the left, dive through a cloud, and swoop down to a lower level. There,



Where men's lives hang by steel threads! Lining a 400-foot stack in New York City from a scaffold suspended inside

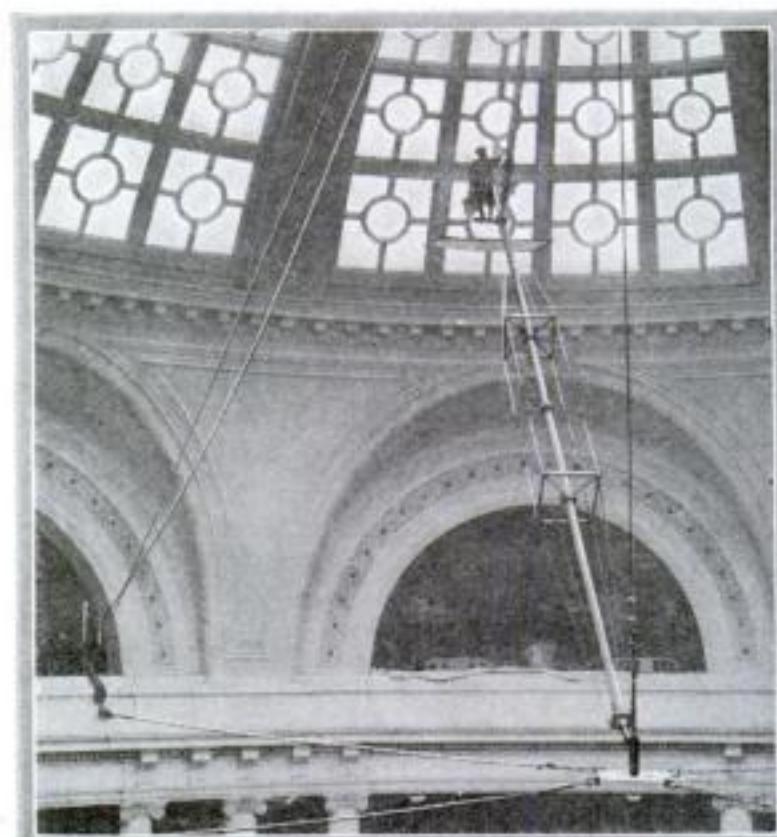
Marvels of Modern Scaffolding

How new steel-swinged "trapezes" remove limitations to building construction and add thrills to worker's job

By ORVILLE H. KNEEN

CAN you imagine how it would feel to do your day's work standing on a swinging scaffold forty stories above the ground? Probably not. Neither could I until a few weeks ago, when I determined to find out what it would be like. Hoisted, by permission of a friendly skyscraper foreman, up through forty stories or so of steel, I climbed gingerly out upon a narrow board walk of two-by-ten-inch planks, and crept to the edge. I peered over the brink a fraction of a second—and then hurriedly grasped the iron guardrail.

Straight down, five hundred feet below, lay a ribbon of cold, hard sidewalk, and not a solitary thing between that sidewalk and me! If one of the planks should let go under my feet!—The thought sent chills down my spine, and I had a feeling as if a pound of lead had been poured into the pit of my stomach. I

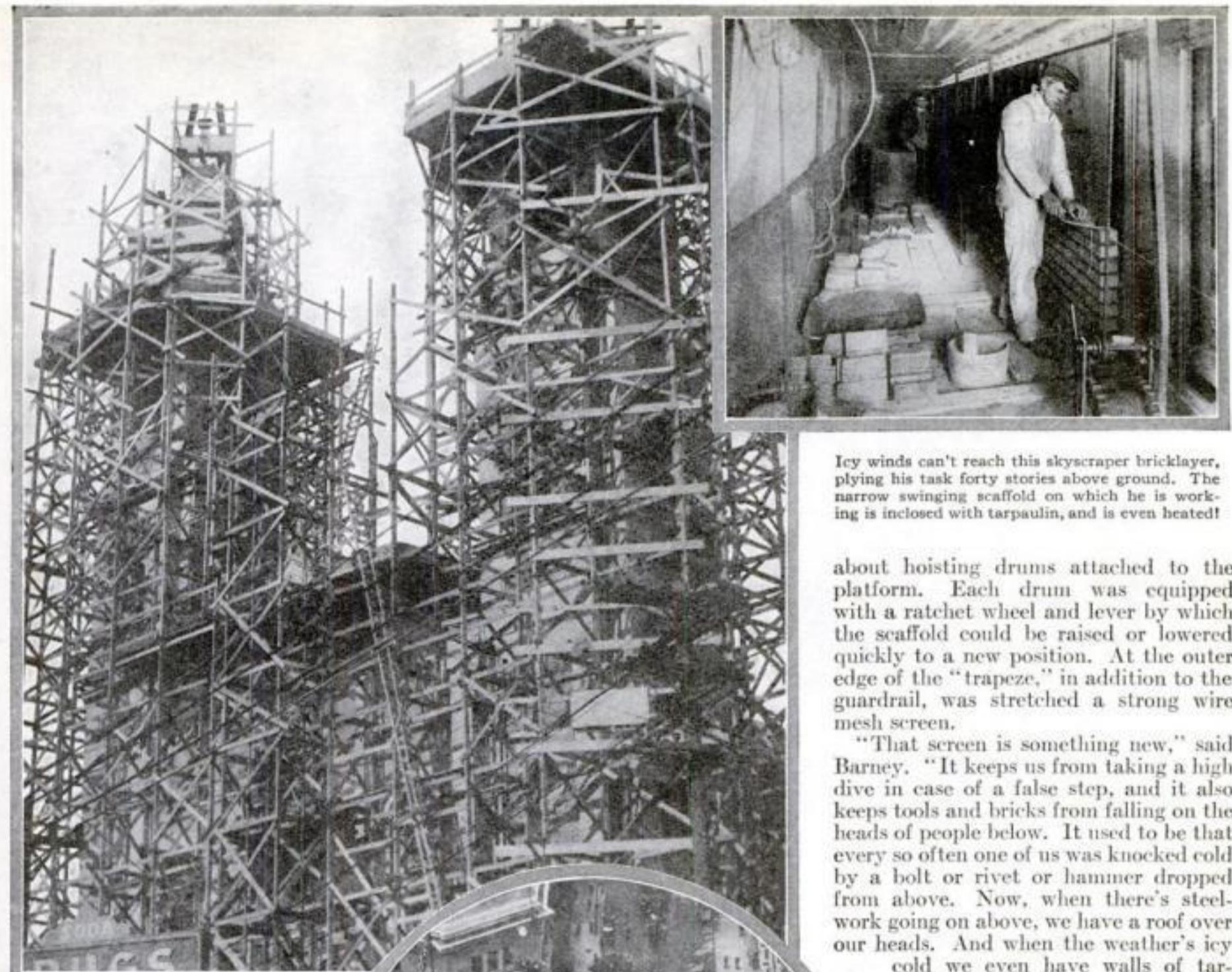


Painting the huge dome of a San Francisco store: an ingenious cable and derrick arrangement swings the painter

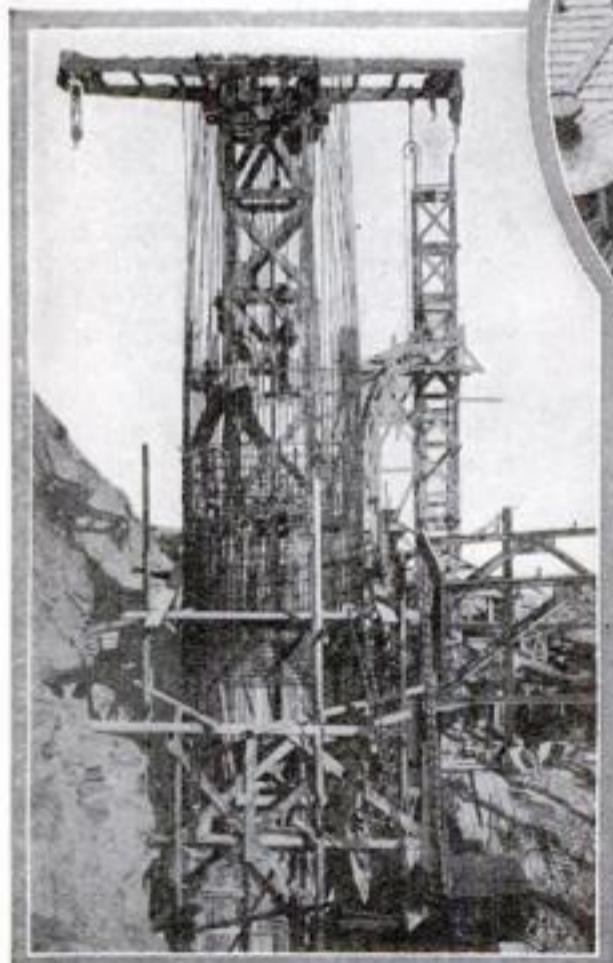
drew back quickly, to look into the eyes of Barney, a strapping bricklayer. My face must have given me away. He was grinning.

"Oh, you'd get used to it," he said good-naturedly. "We all do." We were watching the row of bricklayers and masons along the narrow walk, busily applying flesh and skin to the massive skeleton of steel, and seemingly oblivious to the precipice beneath them.

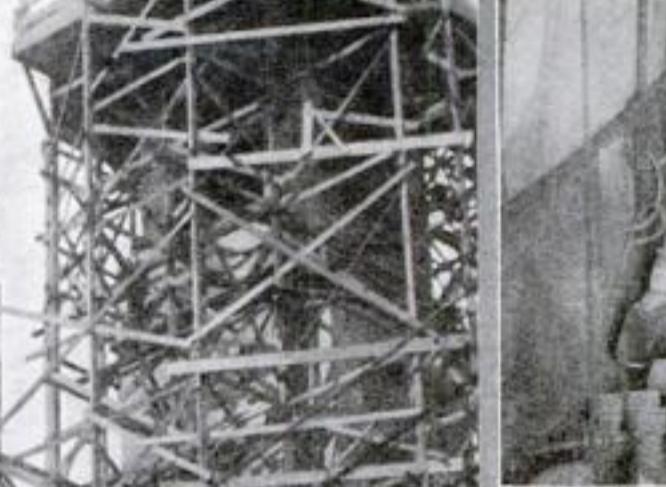
"WITH the tall buildings going up nowadays," explained Barney, "there's hundreds of us who spend every day of our working lives on these swinging trapezes. Sure, there's some danger, but after a while you don't think of it, except to make sure that the rigging is all shipshape. Like a circus, isn't it? Looking up at our perch from below, you'd think we're risking our necks every minute. Maybe we are—but it's nothing to what



This scaffolding made possible the building of a new church around the old one, without the interruption of any of the usual church services



How a San Francisco contractor speeds up work on concrete chimneys: block and tackle on powerful outriggers lift the concrete forms



Icy winds can't reach this skyscraper bricklayer, plying his task forty stories above ground. The narrow swinging scaffold on which he is working is inclosed with tarpaulin, and is even heated!

about hoisting drums attached to the platform. Each drum was equipped with a ratchet wheel and lever by which the scaffold could be raised or lowered quickly to a new position. At the outer edge of the "trapeze," in addition to the guardrail, was stretched a strong wire mesh screen.

"That screen is something new," said Barney. "It keeps us from taking a high dive in case of a false step, and it also keeps tools and bricks from falling on the heads of people below. It used to be that every so often one of us was knocked cold by a bolt or rivet or hammer dropped from above. Now, when there's steel-work going on above, we have a roof over our heads. And when the weather's icy cold we even have walls of tarpaulin around us and a stove to keep us warm! It's a cinch!"

IBEGAN to be almost convinced that working up there in the clouds might not be so bad, after all—if one kept from looking down. That swinging safety scaffold, I learned, represents one of the last words in ingenious mechanical contrivances that have made possible the safe construction of our great modern skyscrapers. Such inventions, mechanically adjustable to any height, enabled workmen to scale the sides of the sixty-story Woolworth Building and build its terra cotta face. They enabled other workmen to lay the three million face bricks of the Equitable Building, long famous as the largest office structure in the world.

With other machines, hoists and elevators, they have made it practicable to plan for such giants as the projected eighty-five-story Book Tower in Detroit and the proposed Larkin Tower in New York, to rise 110 stories to a height of nearly a quarter of a mile. Indeed, engineers say that because of modern scaffolding and hoisting machinery, 2,000-foot buildings, rising 200 stories, have been brought within the range of possibility.

Usually, when we think of skyscraper construction, we picture powerful steam shovels excavating (*Continued on page 128*)



Courtesy
Patent
Scaffolding
Company

Inspecting a scaffold ten stories above Wall Street, New York—one loose bolt may cost a man's life

it was a few years ago, when they used to say that every new story cost a life. Nowadays—well, you can see for yourself how safe it is—that is, if the height doesn't scare you!"

He pointed up to sturdy steel I-beam outriggers projecting like giant arms from the main structure, where they were anchored by bolts and plates. From these beams hung the scaffold platform, slung like a trapeze from stout steel wire ropes. The upper ends of the ropes were fastened to the outriggers by steel shackles, while the lower ends were coiled

What Does Your Garage Cost You?

*Here Are Practical
Hints That Will Add
to Its Convenience and
Reduce Expenses*

By

JOHN R. McMAHON

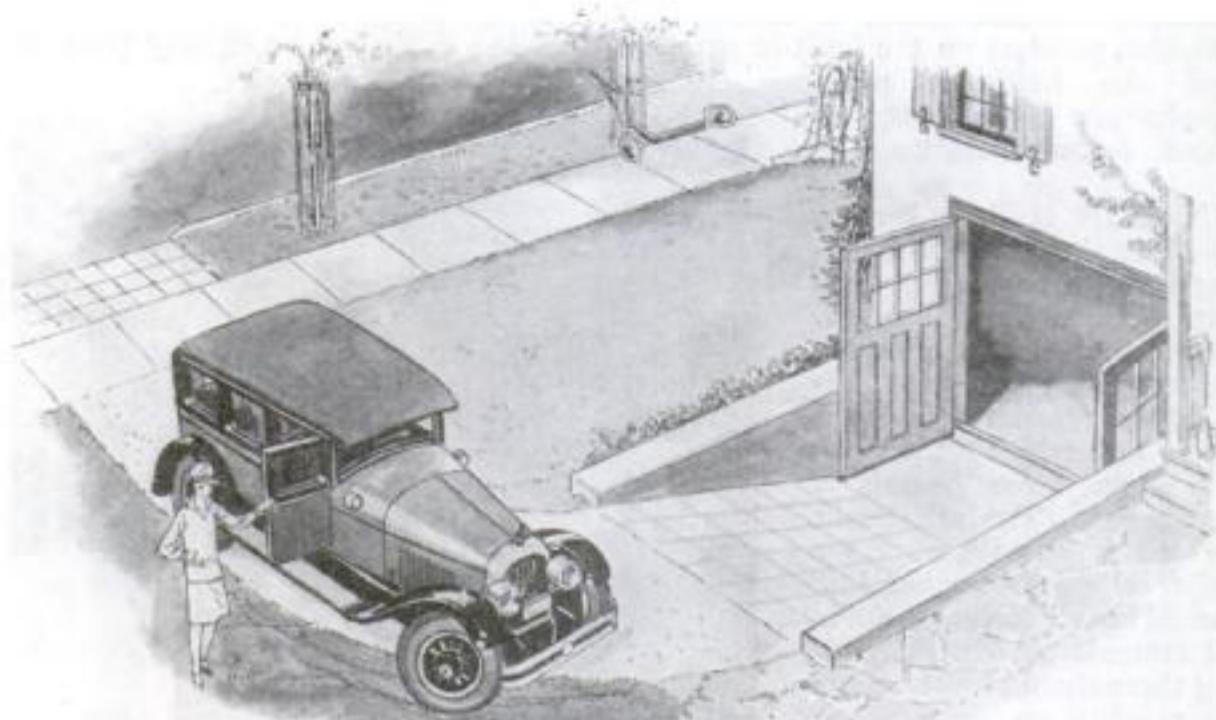
"OUR first garage was an extra stall in a stable," said the reminiscing old-timer. "Its heating system consisted of the body heat given out by the livestock, which generally kept the radiator from freezing in winter. Lighting was by an oil lantern hung on a nail. We thought it quite perfect, until one night a pair of goats broke loose and staged a fight around the car. They smashed a big dent in the copper tubing of the radiator, drenched everything around with spouting water, and wrecked both the headlights.

"After that we didn't think our garage so good any more."

The first man who built a structure especially to house his car was considered snobbish as well as extravagant. The idea was harder to stomach because of a queer foreign name. There was hope when people began to take sides on the question whether to pronounce it garahdge or garidge.

Today almost every house has its garage. Realtors advertise, "Six rooms and garage," or they tell the world about a "Cosy home with built-in garage." People sometimes advertise for a house with a two-car garage, neglecting the minor question whether the house should be at the seashore or on a mountain and have few or many rooms. In time we may expect to see a builder's sign, "Choice garage with home attached."

A CITY man in my neighborhood is spending his spare time building a home with his own hands. He started to erect the garage first, using stone masonry, and now has this structure about completed. It is an intelligent procedure, for the garage will serve admirably to store building materials during construction and will also make a first-class workshop.



Garages poorly located—behind the house or projecting porches in such a position that they are awkward to get in and out of—lose much in convenience. To save your car, garden and temper, place the garage where it can have an unobstructed drive, without sharp curves, to the street

On this job there will be no spoiled cement, warped lumber, stolen tools or makeshift carpentry owing to lack of a convenient work place.

There are too many shoddily built, inconvenient home garages that discourage owners from giving proper attention to their cars, cause expense for trivial repairs that might be done on the premises, and fatten the purses of motor junk yard owners. Three walls, a door and roof do not make a garage. How about heat, water, light and a cement floor? Not to mention space for a work bench and the handiness of a private gas pump. It is usually a simple matter to tinker up a cheap, skimpy garage, equip it with conveniences and make it a place where you like to work; to give it an

attractive outside and an inside worth showing to visitors.

What size should a garage be? An inside width of ten feet is a tight fit, while an added foot or two in width gives fair clearance and room to get around the car. For housing two cars, double these figures. The overall length of automobiles, bumper-equipped, varies from about twelve to about eighteen feet. The latter figure will provide for any medium size car with leeway around the ends.

A factor that may govern length is the type of doors. The ordinary hinged doors opening outward permit full use of garage length, while doors that fold or slide inward may require an extra foot for free operation. Height from floor to ceiling should be eight feet or better, so that the car can be jacked up enough, a touring top raised, and so on. A tackle hook in the ceiling whereby the engine head may be lifted is a handy detail.

WINDOWS should be low so that light falls on machinery rather than on upholstery. In cold climates few and small windows are desirable to save heat. There will be plenty of light in good weather with main doors open, and at other times electric bulbs will supply enough illumination. With small sash anyone can afford to have them double against zero temperatures. One sash may be fitted on the outside and another on the inside of an ordinary window frame, leaving an air space between, and the sash may be held in place with screw buttons of metal. A fly screen for summer and an inner grille to discourage auto thieves are further refinements that cost little, but add to comfort and security.

No doubt a garage built into a house is most convenient, but it entails greater fire risk and involves more careful installation than an adjoining or separate structure. It is well to learn in advance the requirements of any local building code and those of the insurance company that handles your policy. Take



Don't build your garage so small you can't work in it. Its size, of course, depends on ground available, but an inside width of ten feet is a tight fit. An added foot or so is better

your plans to the insurance people and follow their suggestions, otherwise you may be taxed a high premium and may also do a lot of worrying over a hazardous layout. The National Board of Fire Underwriters has issued a number of valuable pointers on the built-in garage, and the following paragraphs are a summary of these recommendations.

IN THE built-in garage, there should be no opening through the garage ceiling. If the building is frame, make the ceiling of three fourths inch Portland cement or gypsum plaster on metal lath which weighs not less than three pounds a square yard. The lath should be well nailed with sixpenny nails clinched over, and it should lap six inches on walls all around. Above the ceiling there should be standard floor joists on sixteen-inch centers and a double floor of seven eighths-inch boards. Between top and bottom flooring, place a layer of asbestos or of noninflammable floor felt. The whole combination is by no means fire-proof; it will merely retard a fire for a period of one hour. Safety can be increased by using thicker plaster and putting a layer of asbestos directly under the metal lath.

If garage walls or partitions are frame, give the studs the same treatment as for the ceiling, that is, metal lath and plaster. It is an improvement to back-plaster between studs, whereby the lath is covered with mortar on both sides. This protects the metal from rust, besides adding to fire security. If walls or partitions do not embody wood, a lesser thickness is allowable: four inches for brick, hollow tile, concrete block or gypsum block, and three inches for reinforced concrete.

Again we must note that these are minimum, not to say skimpy provisions toward safety. It would be better to have thicker masonry, or at least to cover it inside with wire mesh or metal lath and plaster. A continuous sheet of metal-reinforced plaster safeguards against cracks and crumbling mortar between the units of masonry.

WIRE glass and metal framework are advised for doors and windows of the built-in garage. Only one opening between garage and house is permissible, and this should be equipped with a standard fire door of the swinging self-closing type. The door should have no glass in it, and it should never be propped or tied open. When the doorway connects directly with a cellar in which there is a furnace or heater, there must be a sill at least one foot higher than the level of the garage floor; or there must

be a vestibule with a second door leading into the cellar. The raised sill is explained by the fact that gasoline fumes accumulate near the ground and are checked from spreading by the sill barrier. The vestibule option mentioned above presumes that two doors will be equally protective

drainage of vapor, which is highly important, will take care of itself in a floor that is correctly sloped and equipped to carry away liquids.

Of course there should be no stove or heater within the built-in garage, unless in a compartment as secure as the rest of the structure and having a fire door closing against a raised sill. Only electric light is allowable. There is a ban against floor pits. Any gas supply beyond that in the car tank and a five-gallon can must be kept in an underground tank at least three feet below the surface.

THE attached garage may be as convenient as the built-in, and by harmonizing its lines with those of the house it may appear part of the original dwelling. The house roof may be extended over it. An extra room, sun parlor or sleeping porch may be built above it. If the garage is no more than a box with a flat roof, it may be ornamented with a lattice coping and with flower boxes, and have ivy or flowering vines on its walls. The advantages of attachment to the house are obvious in heating, lighting and water supply, as well as convenient access and security against theft.

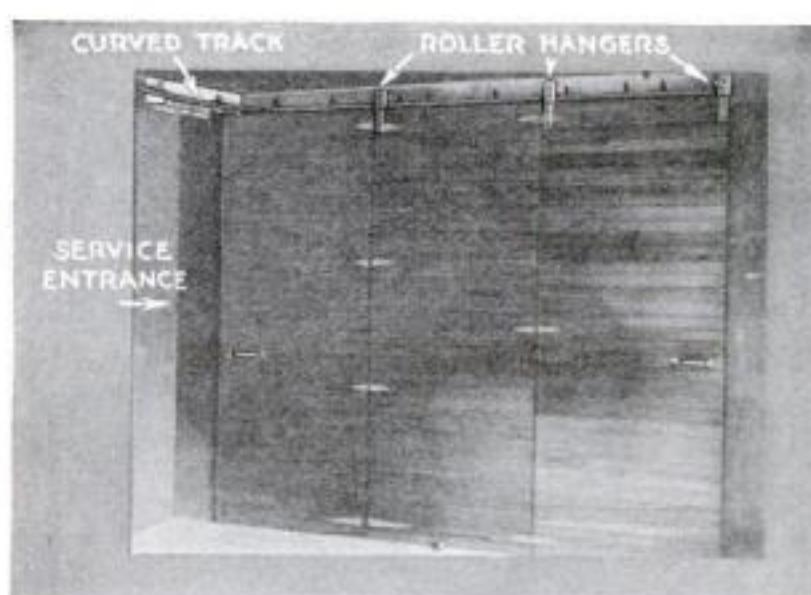
Some owners of the attached garage prefer to sacrifice a trifle of convenience for the sake of greater fire safety, by having no direct house entrance. At the same time they save the price of a fire door, which may amount to fifty dollars.

Whatever the location or general material, every "car stable" deserves a concrete floor and concrete or masonry foundations below the frost line. A proper floor can be easily cleaned of oil and grease with kerosene and a long-handled scrubbing brush; it can be swept out and hose-flushed so that the owner can inspect the underside of his car even in his best clothes. Such a floor excludes vermin, is fire-safe, and makes it easy to move the car by hand. It needs a six-inch base of well tamped cinders or gravel, and over this a four-inch thickness of concrete, which may have a surface finish of rich, troweled cement half an inch or so in thickness.

THE best plan is to slope the floor from all sides toward a center drain trap of cast iron with perforated top plate, the drain being connected with a tile line extending outdoors. This job is not so difficult as it seems. Drive nails at the height of the finished floor in the four corners, extend cords from nails to center, which is one and one-half inches lower. Make the cinder base conform to cord slope, likewise the concrete layer. A plank straight edge will *(Continued on page 132)*



Have a center drain in the garage floor. You can make this by following diagonal lines, as shown here. (Upper photo) An "overhead" type of garage door. It is built in hinged sections that slide up out of the way on tracks



Smooth-working in-sliding doors are more convenient than out-swinging ones, and this picture, an inside view, shows how they can be made. The hinges, track and rollers are inside

against spreading of the poisonous vapor.

The floor of the built-in garage should be concrete, with a slope that will drain gas, oil and water outside. The invisible

Shall We Scrap the Yardstick?

With two kinds of miles, three pounds, many arbitrary units, our measuring system is called antiquated

By ALDEN P. ARMAGNAC

"ARR-MAY! Rah! Rah! TEAM!" Across the gridiron, hurled from the throats of the cadets that pack the stand, comes the Millimeter Yell. There is a history behind it. Shortest football cheer of West Point's repertoire, the Millimeter Yell is named after a diminutive fragment of a measuring scale based on a mysterious beam of red light—a scale universally known as the metric system.

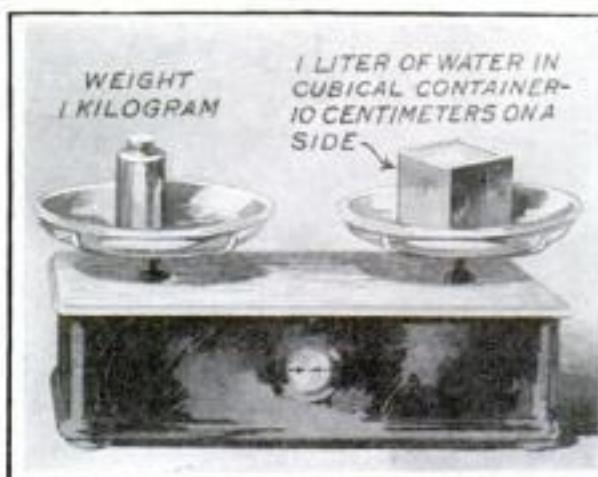
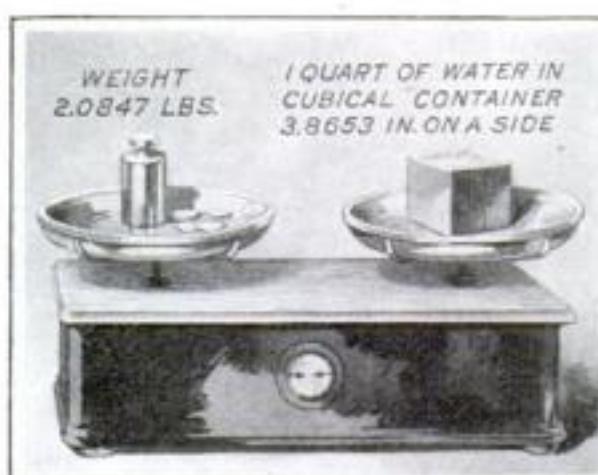
When you weigh yourself on a slot machine, or stop your car to read "4 Miles to Blankville," you are using specimens of a time-honored collection of standards that is the English system of weights and measures. Yet there is talk of changing them. Tomorrow your weighing machine may tell you that you weigh seventy kilograms; the signpost may read, "Blankville—6 Kilometers."

In Congress resolutions have been introduced that, if passed, would put the metric system in everyday use throughout the country. The metric system, say its advocates, is uniform; it is easy to learn and easy to use; and every civilized country but two—England and the United States—is using it. Shall we adopt it?

You are laden down with three kinds of weights. You use an "avoirdupois pound" to weigh all ordinary things; a lighter "troy pound" for gold, silver and jewels; and the same pound, disguised under the name of "apothecaries' pound" and differently divided, to measure out prescriptions at the corner drug store. Besides your two distinct miles, you have the furlong, span, hand, pennyweight, scruple, line and firkin to annoy you.

ENGLAND'S gallon and ours are not the same. The gas station attendant at our Canadian border urges motorists to replenish their tanks before they cross the line. "Better fill 'er up—it'll cost you several cents more a gallon on the other side." He neglects to add that the Imperial gallon of Britain and Canada contains nearly a quart more than ours. For that matter, our yards and inches are different. It is not generally known that in 1893 the meter became the official standard of this country, and that now by law the U. S. yard and inch are redefined as fractions of a meter. For, though other units may vary, a meter is a meter the world over.

In the metric system, the meter—a little longer than our yard—is the



The metric system is easy to use because its units of volume, length and weight bear the simple relationship shown above. Contrast this with the complicated decimals you get in reckoning the same relationship in our "English" system, shown in the upper picture

sole standard. Volume and weight measures are ingeniously derived from it. A centimeter, decimal of the meter, yields the "cubic centimeter" that, with its big brother, the "liter," measures all volumes. The weight of one "c.c." or cubic centimeter, of pure water is a "gram," fundamental metric unit of weight.

And there you have the whole system

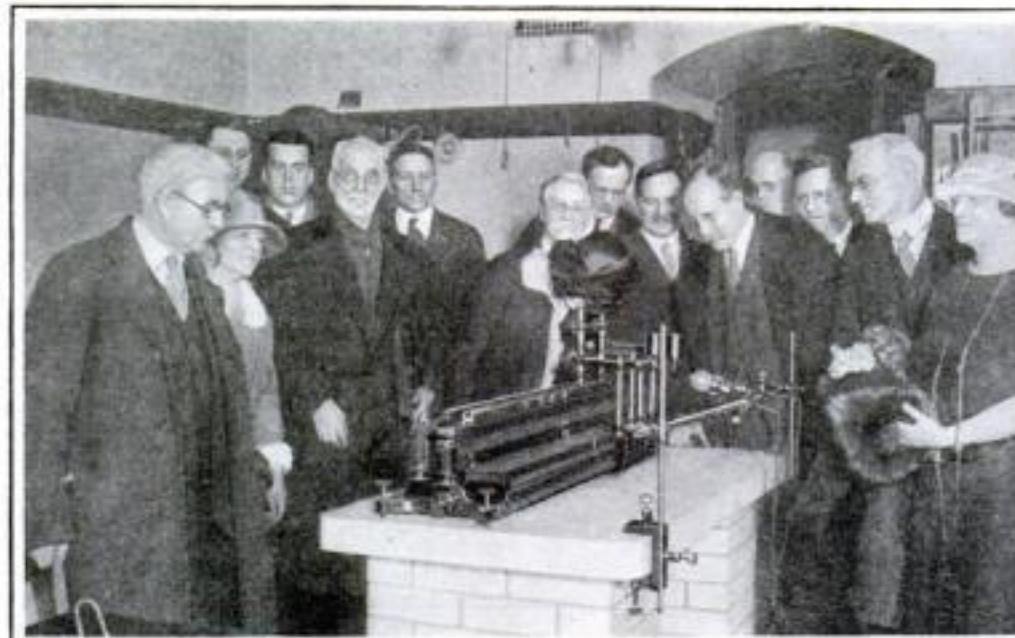
in its amazing simplicity. Your pound and quart are hardly on speaking terms with each other; your inch will acknowledge only a casual relationship with either. But in the metric system a given volume of water or of anything else has an instantly calculable weight and size. To a schoolboy, that means finishing his lessons in a few minutes; to industry, an incalculable saving in brain power to be diverted to other useful fields.

MOREOVER, urge the metric supporters, all metric units are divided in tens. You think in tens, they say. You do all your figuring with the symbols 1 2 3 4 5 6 7 8 9 0. Therefore, why not be consistent and use weights and measures that, like your decimal coinage, will be in harmony with this number system? It's an unusual man who can say offhand how many square feet there are in an acre; but any French schoolboy will tell you that a hectare, the corresponding metric unit, contains a thousand square meters. It is an easy figure to remember, and a handy one to figure with.

An average-sized drop of water and a plump grain of wheat are the original sources of two of our smallest measures of volume and weight, the minim and the grain. Is it surprising that our scientists abandoned that system and now use the metric system for their delicate laboratory work? The chemist who makes an error of half a teaspoonful stands an excellent chance of being blown into eternity.

When it comes to measuring length, the English system as commonly used can provide nothing smaller than the inch—immediately divided into grotesque fractions such as thirty-seconds and sixtieths. Lately, some geniuses have been using decimal fractions of an inch in fine manufacturing work; but it is incongruous to write a measurement in feet, in twelfths of a foot, and in decimals of the twelfths of a foot. In the metric system, completely decimalized, the infinitesimally small "millimicron" measures light waves only a billionth of a meter long. Yet this value in written figures may be tacked directly on the end of a metric length equaling several miles without incongruity.

As early as 1585, Simon Stevin of Belgium published a book, "La Disme," in which he set forth the benefits of a decimal system of weights and measures. But it was not until (Continued on page 130)



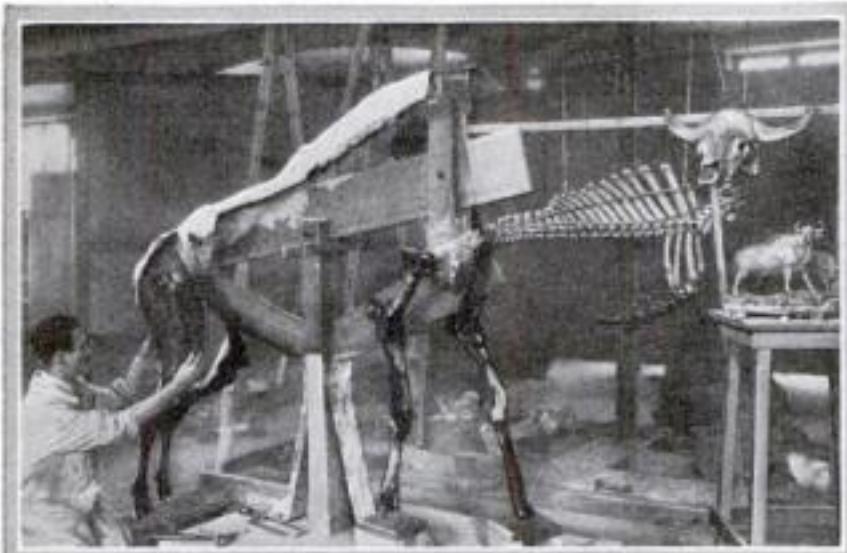
At the U. S. Bureau of Standards is kept a copy of the world's standard meter, rigidly guarded at Sevres, France. A group of scientists is seen here examining it

The Strangest Art in the World

How Taxidermy Makes Animals "Live Again," Shown in a Remarkable Set of Photos of the late Carl Akeley's Methods—The Pictures Are the First to Show the Complete Operation and Took Seven Months to Obtain—The Animal Is an East Indian Wild Ox



The finishing touches: repairing imperfections in the skin. This is the last step before the animal is placed in the museum. Starting with 1, below, and following the steps in order, you will have a complete picture of the interesting methods of modern taxidermists



1 The first step is the construction of an "armature," or framework of boards, using some of the animal's bones. This is then covered with wire netting, bulging to approximate the size of the animal. Note the model of the finished figure, at right



2 Over the wire netting is then roughly applied a coat of plaster of Paris, to serve as a base for the next coat of modeling clay. This next step, modeling with clay, is the most important of the whole process

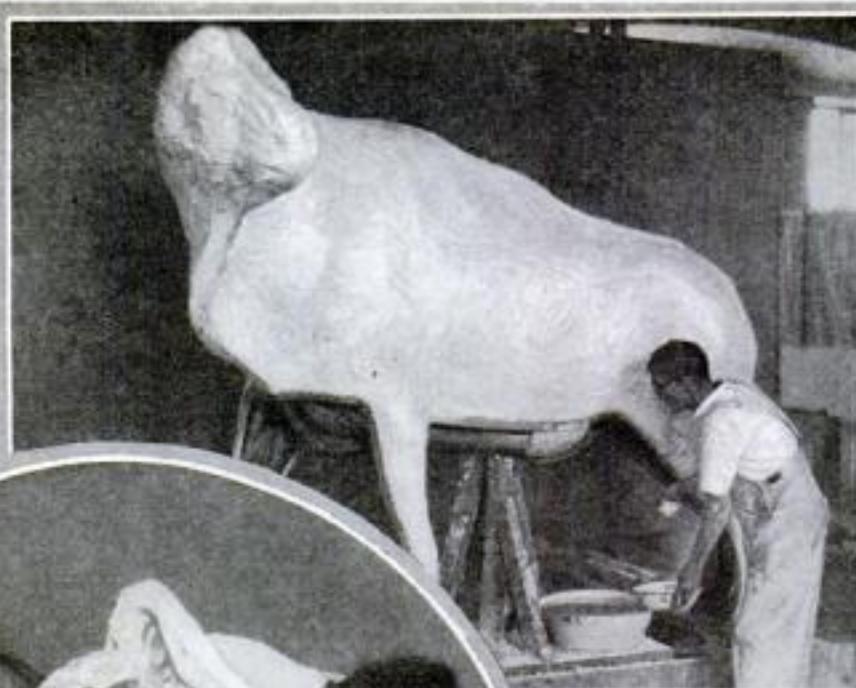


3 (Left) Applying the modeling clay to the plaster of Paris. Every muscle and vein of the ox is clearly emphasized



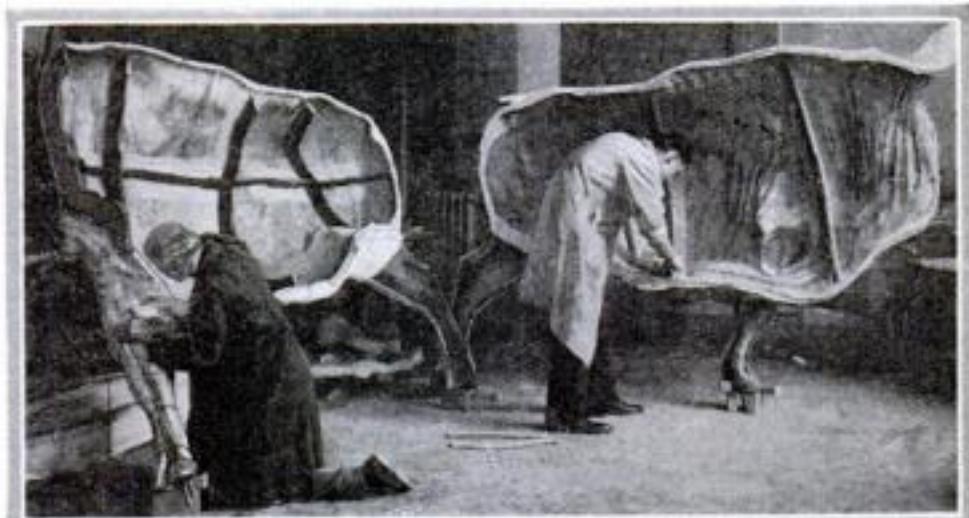
4 The finished clay model—a fine piece of sculpture. It looks as though all it needs is the skin, but there still remains much work to be done

5 (Right) Over the finished clay model, plaster is applied, which, when hardened, can be removed as a plaster mold, having the imprint of the animal on its inside. This plaster mold is in four sections, to facilitate its removal

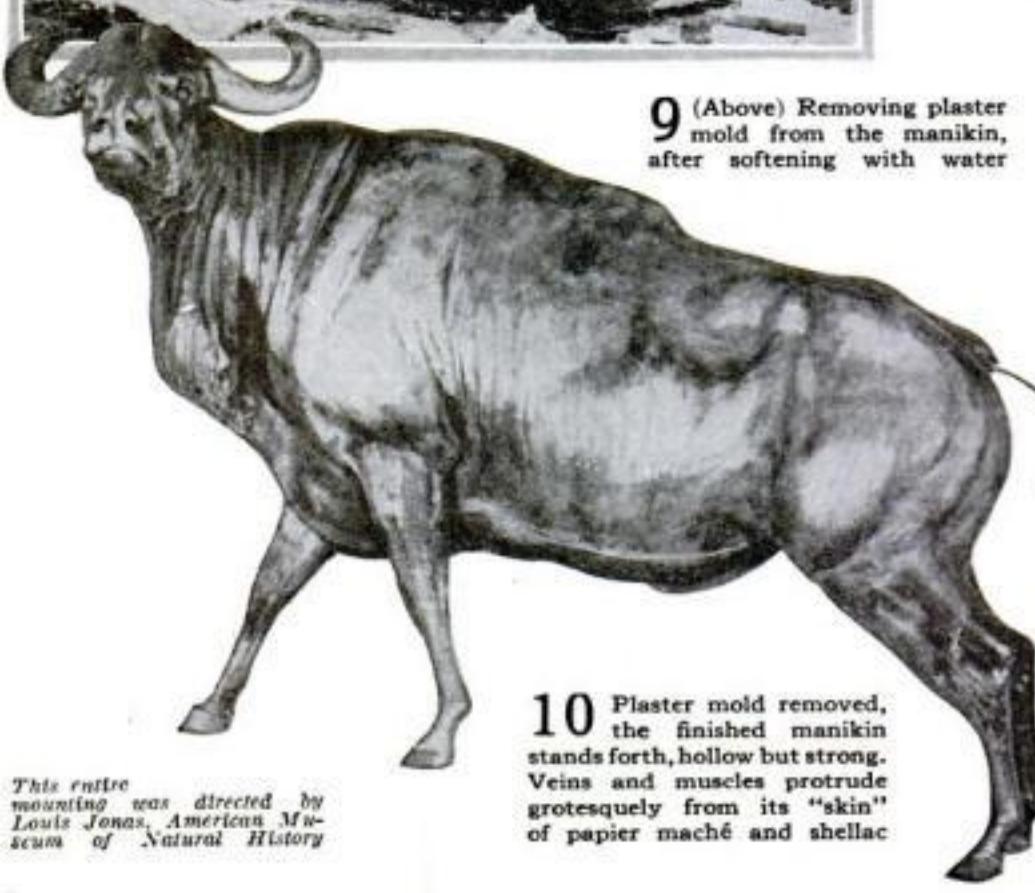


6 (Left) Thoroughly hardened, the plaster mold is removed in sections. The original clay model is from now on of no importance—in fact, in this case its head was demolished to remove the plaster mold intact

7 (Below) Now the inside of each section of the plaster mold is stuffed tightly with a combination of fabric, wire mesh and papier maché made rigid with shellac, which forms a strong "manikin"



8 (Above) The manikin "walls," still with the plaster mold covering them on the outside, are now braced with wooden crosspieces on the inside, and the sections fastened together. The plaster is then soaked with water to remove it from the manikin



9 (Above) Removing plaster mold from the manikin, after softening with water



10 Plaster mold removed, the finished manikin stands forth, hollow but strong. Veins and muscles protrude grotesquely from its "skin" of papier maché and shellac

11 The last step—clothing the reconstructed beast with his original pelt, which is fitted tightly to the body's ridges and hollows. Even the tail and slender legs are cunningly sewn up so that not a seam is discernible. Now, at last, the gaur emerges in all his majesty

Bare Hands

By HAWTHORNE DANIEL

Illustrated by J. Clinton Shepherd

PARKER and Thornton, partners in a Seattle engineering firm, and Williams, a young naval architect, were enjoying a pleasure cruise among the Aleutian Islands in the latter's yawl when, with their deck hand, Kelly, they fell into the hands of Kiska Joe, a notorious half-breed seal poacher, and his crew of native Aleuts. Undecided whether to murder his captives, Kiska Joe imprisoned them in their own yawl; then, having placed Oomak and two other Aleuts in charge, he returned to his schooner. Together the two ships sailed westward. Separated from the schooner in a fog, the yawl was wrecked on the rocks. Two of the Aleuts made away in a small boat, while the four white men and Oomak struggled through the sea to the beach of a desolate and apparently uninhabited island. Thornton, the natural leader of the group, managed to build a fire without matches, then directed his comrades—Parker, Williams and Kelly—in the task of providing shelter in a shallow cave and of catching birds for food. Oomak, mysteriously frightened and nervous, explained that the place was known as Devil's Island, inhabited by devils whom Kiska Joe occasionally appeased with gifts. Later, as the men huddled about the fire, pondering their fate, suddenly there arose a weird and dreadful cry that echoed across the cliffs, finally disappearing as mysteriously as it had come. Oomak, whimpering, groveled in the sand. All this was told in the first installment published in last month's issue of *POPULAR SCIENCE MONTHLY*. Now read on:

THEY listened again for the cry, but it had gone. They crouched close to the fire and shivered, though they were warm. They spoke in guarded tones, and glanced about, fearful lest some enemy might creep upon them. But the sound was not renewed, and gradually they recovered their assurance and their reasoning faculties.

"Could it have been an animal?" asked Parker, nervously.

"I doubt it," replied Thornton. "I have been frightened by bobcats, and I've heard coyotes and wolves. I've heard mountain lions and a lot of other things that make weird sounds, but what we heard was nothing like those. It sounded human to me—wildly, terribly human. Yet Oomak says the island is uninhabited."

He paused.

"Oh, the devil!" he went on. "Who'll go with me? I'm going to see if I can't find some trace of it."

The group fell rather sheepishly quiet, until Kelly frowned and got to his feet.

"I'll go," he announced. "But I want a club."

"So do I," admitted Thornton.

But though they searched for an hour they could find no trace of what had made the sound, and so returned to the fire, still mystified. Thornton sat beside the fire, and presently found himself pondering again the difficulties that faced them.

He tried to think of elemental things which they most required. "Fire?" he thought. "We have it. That's settled. Food? That's easy. Shelter? O.K., until we can find a better place. Clothes? Yes, rabbits. We have lots of them. Then what?" He sat staring at the fire. "Tools," he said finally, aloud.

"Tools?" repeated Parker. "What are you talking about?"

Thornton was about to reply when Williams and Kelly came trudging up with great armfuls of wood that they threw on the

growing woodpile. Oomak, having cleaned his fish, brought them to the fire with a long green stick thrust through them, so they could be smoked above the blaze.

"We need tools in order to live," said Thornton, returning to the subject. "And we can find them, too, or make them—somehow."

"Do what?" asked Williams, who had heard only the end of Thornton's remark.

"Tools," repeated Thornton. "We have to make some. Then we have to get rabbits and make clothes of their skins."

"How will you tan the skins?" asked Williams.

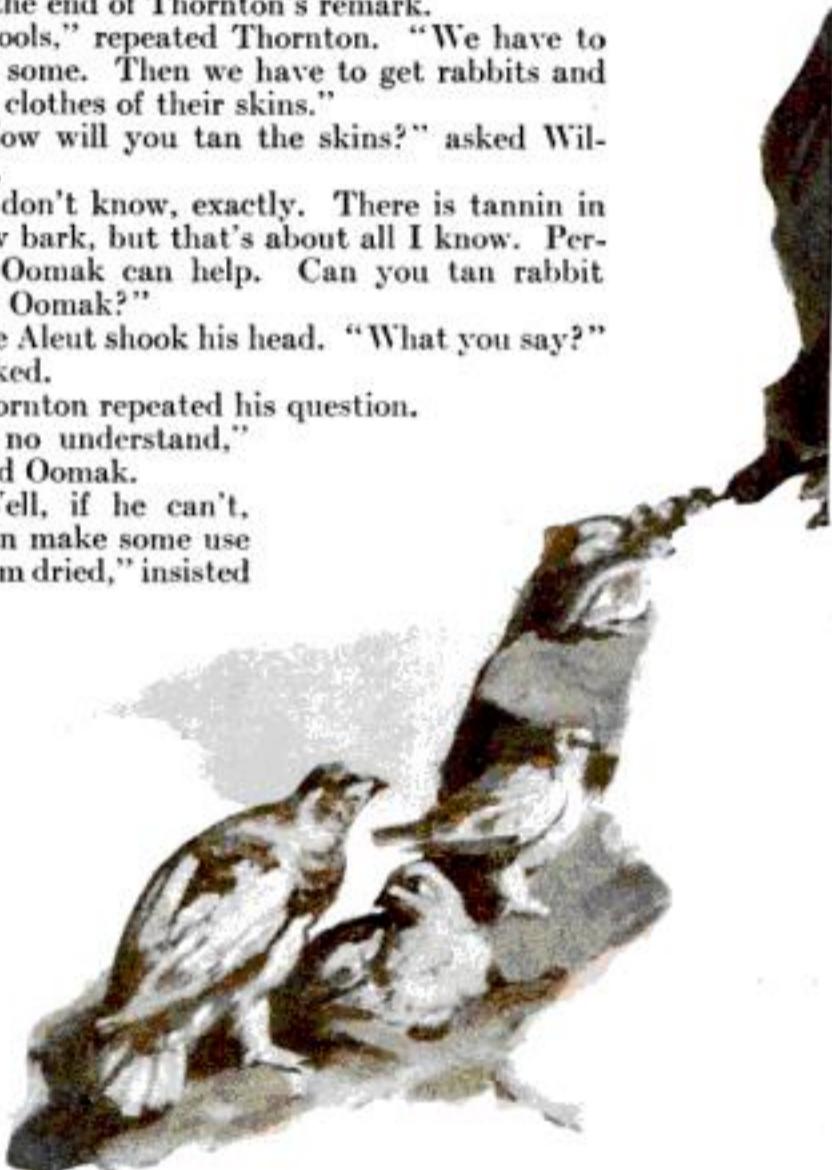
"I don't know, exactly. There is tannin in willow bark, but that's about all I know. Perhaps Oomak can help. Can you tan rabbit skins, Oomak?"

The Aleut shook his head. "What you say?" he asked.

Thornton repeated his question.

"I no understand," replied Oomak.

"Well, if he can't, we can make some use of them dried," insisted



Thornton. "Now listen. It's getting late, and we'd better not get far from here tonight. But we're going to get out of this fix. How, I don't know. But first we need clothes. Second, we need tools. We'll start first thing in the morning to get both."

Despite the fire burning before the shallow cave everyone was cold that night. But the fire at least kept them from freezing. In the morning they were up with the earliest dawn, ready to start on their quest.

Oomak refused to leave the imagined safety of the fire and the cave, and Parker, the impractical theorist, obviously would not be highly useful on such an expedition as was planned. Furthermore, he belittled their efforts.

"Ridiculous," he sneered. "Suppose you made your tools,



With practice, the castaways became skilful at catching ptarmigans. These willow-grouse of the north they chased across the rocks of the island and killed with clubs. Thus the problem of obtaining food simplified itself.

although you can't. But even if you had them, what good would they do you? What we need most is the fire and food. And we ought to watch for passing ships. One will be along soon, and we can signal it. You'll waste your time and run needless risks wandering about unarmed. Count me out. I'll do something useful."

No one replied, but both Williams and Kelly seemed more willing to follow Thornton's suggestion than Parker's. So it was that just as the sun rose the three started on their exploring trip. At first they planned to go together for protection, then decided not to; so, armed with clubs, Thornton took himself off up the ravine through which the stream flowed, while Kelly went off to the north along the shore, and Williams to the south.

FOR a quarter of an hour Thornton struggled up the narrow, steep ravine. He went warily, for he had no idea of what he might face. Once out of the ravine he found himself on a high and more or less level stretch. He climbed to the top of a small hill, and saw that the island was alone in the vast expanse of sea. No land was visible in any direction, and the island itself was small—hardly more than four or five miles long by half as wide. Here and there were clumps of trees, mostly along the edge of the cliff above their camp. For most of the rest of its extent the ground was covered with moss and little clumps of grass and willow. Rabbits scurried here and there. Birds flew overhead. But he saw no signs of any large animals or of men. Certainly the island was uninhabited.

It was noon before the three explorers returned to camp. None of them had seen any signs of habitation or of Oomak's devils. Thornton was the first to arrive, and in his hands were three rabbits. He found that Parker had done nothing but wonder how to erect a signal, while Oomak had kept the fire going. But Thornton pretended not to notice Parker's inactivity. Instead, he held his rabbits up proudly as he came limping

back to the fire, where he sat for a time soaking up the heat.

"The little rascals," he said finally. "I saw plenty of them, but I never knew how hard they were to catch."

Oomak grinned as he started skinning them with his teeth. It was amazing to the white men to see how simply he performed the task. Half a dozen bites, and he had broken the skin of the first one. He stripped it from the hind legs of the animal, and began to peel it off, turning it inside out as he did so. The skin came off whole, without a break, save where he had bitten. Next he ran to a willow bush that grew a little way off, broke several branches, returned, and almost in a moment had a branch bent double and thrust within the skin, distending it. He set it up against a rock and began on the second rabbit.

"**T**HAT looks simple," commented Thornton, "but I doubt if you could do it, Parker."

"Do it?" asked Parker. "Of course I couldn't do it. It's disgusting the way he bites the skin."

"It may be disgusting," replied Thornton, "but you'll be mighty glad to get a pair of pants made out of rabbit skins. There are plenty here to make

clothes for us, if we can catch them."

"Waste of time," objected Parker. "We'll be picked up long before you can accomplish that. Did you get anything useful?"

"A few bits of stone that we may be able to use," replied Thornton. "But there weren't many up there. Mostly covered with grass and moss, once I got out of the ravine. There comes Williams. Maybe he has something."

Williams came shuffling in with one sandal nearly off, and with his arms full of sticks and stones.

"Saw a seal," he shouted, "but I couldn't get him."

"What luck?" asked Thornton in return.

"So so," replied Williams, stopping beside the fire and dropping a strange assortment of oddly shaped stones and sticks. In one stout branch he had thrust a sharp stone, making a very crude axe. The other stones were of many shapes and sizes—some sharp, some pointed, some thin and capable of being chipped.

"Pretty good," offered Thornton, while Parker looked on doubtfully.

"Good for what?" asked Parker, disparagingly.

Thornton smiled.

"Good if we can't do better," he replied. "We might worry a tree down with that axe, if our patience held and the stone didn't break."

He picked up a small, thin rock and broke it on another. It slivered to a fine, sharp point, and he picked up one of Oomak's fire-sharpened spears.

"You can make a spearhead out of that," suggested Parker, despite his lack of enthusiasm.

"That's what I thought," replied Thornton, "and that's what Williams brought it in for."

Parker picked up another piece and turned it over and over.

"Of course," he began, "you're wasting your time, for you won't need it, but this stone can be made into a fairly good sort

of blade. It's obsidian." He held it up to the sunlight. "You see? Where it is broken it shows a conchoidal fracture, like that of glass. If I remember correctly it was first discovered in Ethiopia in Greek times, by one Obsius, and here we find it on this desolate island. It's volcanic in origin. It seems to me," he went on, "that I have read something about the uses to which savage peoples have put it. It is brittle, of course, and so you can't use it for the tools you want so badly. Still, natives sometimes use it for arrowheads, and even for knives and razors."

WILLIAMS looked at Parker in surprise.

"Well, where did you learn all that?" he asked.

"Oh, I've taken some interest in geology," replied Parker. "Never used it much, any more than you'll use this obsidian, but it interested me."

They heard Kelly shout as he appeared from the big pile of boulders at their backs, and in a moment he dropped a double armful of vari-shaped stones at their feet.

"What did you find, Kelly?" asked Thornton, turning hopefully to the deck hand.

"Nothin' much," replied the sailor. "It's awful rocky up that way. There ain't a thing for a mile but big rocks that's all tumbled over. And then there's a little inlet, and I found these almost all in one place. Lots more of the same stuff, but there ain't a sharp one in the lot. The rock ain't hard enough. Not much good for tools, I'd say."

Parker carelessly picked up one of the stones that Kelly had dropped, and looked at it. He turned it over and looked again.

"**MAGNETITE**," he announced. "With all the time in the world you can't make tools out of this. Obsidian may serve a bit, if we are here long enough. But not this stuff."

He pitched the stone he held over his shoulder.

Thornton stared at Parker in amazement. For a moment he gulped and could say nothing.

"Magnetite!" he finally gasped. "Are you sure?"

"Why, certainly," replied Parker, testily. "It's an exceedingly common thing. Occurs all over the world, and sometimes forms deposits important as iron ore. It's an oxide of iron, Fe_3O_4 , I believe."

Thornton seized a bit of the ore and turned it over. He scratched it with another bit, and a black line showed on it.

"By George," he cried, "you're right! That's wonderful!"

"It would be," replied Parker, raising his eyebrows, "if the deposit were of any size and if it were closer to civilization. But as it is, it's worthless. Small deposit, undoubtedly, even if the whole island were made of it, and there's too much elsewhere in the world. It's entirely worthless."

"Worthless?" shouted Thornton, springing to his feet. "Worthless? It's everything. Now we can make *real* tools!"

The group about him looked blankly at his delighted face.

"Out of what?" asked Williams.

"Out of iron," shouted Thornton. "Out of steel!" He waved his bit of magnetite in the air. "All we have to do is to smelt it!"

"Ridiculous," scoffed Parker.

"Why?" asked Williams. "Can't it be done?"

"Of course it can be done," admitted Parker, "in a blast furnace. But we have no blast furnace."

"Then by George, we'll have one!" shouted Thornton. "Iron. Steel! And watch me make tools!"



Oomak now had a spear tipped with obsidian, and with this he caught fish in the stream. The sharp spear head was made from bits of the volcanic rock which Williams had found on the island

"Tommyrot," insisted Parker.

Thornton's excitement over the discovery of the magnetite communicated itself to Williams and Kelly, although Parker still jeered.

"Ridiculous," he repeated. "Perfectly ridiculous. You'll sweat and labor and fume and accomplish nothing."

"Don't be so sure!" replied Thornton. "Do you mean to tell us that we can't do what any number of savage tribes can do? Do you think for a moment we can't smelt iron as well as the Masai and Kikuyu and other native tribes in Africa? They make spears and swords from metal they smelt themselves. If they can do it, certainly we can make axes and knives and other simple tools."

"**NONSENSE**," objected Parker. "Don't try to tell me that African natives can reduce iron ore and make their spears. They are probably made in Sheffield and sent out to African trading posts. It's ridiculous to suppose that savages have enough knowledge and mechanical ability to perform so complicated a

task. I, for one, don't believe they ever did such a thing."

"That's merely another of your theories," insisted Thornton. "If you had ever interested yourself in such matters, and had ever gone through a really fine museum—the American Museum of Natural History in New York, for instance, or the National Museum in Washington—you would know that you are wrong. I have talked with men who have studied the natives, and I know just how they reduce their ore and work their metal. And if I didn't, I could work out methods of my own. The trouble with you is that you require a laboratory and all the equipment in the world before you can think of attempting so simple a task as smelting iron ore."

He turned from Parker to the others.

"What shall our first iron tool be?" he asked.

"An axe," replied Williams.

Thornton smiled and shook his head.

"Wrong," he announced. "It will be a hammer."

Parker laughed sarcastically.

"A highly important tool," he remarked, "to go to so much trouble to secure."

BUT Thornton paid no attention to the remark. He realized that his own viewpoint and Parker's differed sharply. He knew, too, that they were likely to be together on the island for a considerable time. His experience in the wilds had shown him that sharp divergences of opinion sometimes became almost unbearable. He knew even of instances where men had killed their best friends in sudden fits of uncontrollable temper gradually aroused by long disagreements over trifling matters. But Parker, he knew, had no conception of such serious difficulties, and probably would continue to be biting and sarcastic, derisive, mocking. Therefore, Thornton thought, he himself would have to carry the major part of the burden, would have to be forbearing and considerate. Already he had given way to anger and direct speech. He must be more careful, and more considerate. It was not Parker's fault that he was a misfit in their present predicament. He was a highly specialized creature intended for and very successful under the conditions which, until now, had always surrounded him. So Thornton paid no attention to Parker's sarcasm, and explained his viewpoint to Williams and Kelly.

"The first tool we manage to make," he remarked, "is bound

to be crude—that's to be expected."

"No doubt about it," interjected Parker.

"And so," went on Thornton, "we want to make one that will be of some use to us in making the second one a more finished product. For that job, nothing could be more useful than a hammer."

"Right," nodded Williams. "Quite right."

THEN what?" asked Kelly.

"Anything," replied Thornton. "Axes, knives, fishhooks, spearheads, arrowheads, adzes—we'll need adzes more than anything else if we have to build a boat."

"Build a boat?" asked Williams.

"Why not?" asked Thornton. "With tools and nails—"

"Sure enough," admitted Kelly. "We can make nails."

"Certainly, if you can make anything," sneered Parker, "but don't you think that before you make all these tools you had better see if you can get the iron? I have my doubts. It really requires a blast furnace."

"Then we start at once making a blast furnace," insisted Thornton.

But the blast furnace was not so easy to build as it at first seemed. It was not difficult to erect a chimneylike structure five or six feet high, nor was it troublesome to line it with clay taken from the stream. But some apparatus had to be constructed to force air into the base of it, and in order to make bellows, skins were required. Furthermore, the whole party was beginning to suffer from the effects of cold, and it was obvious that skins, for clothes and for bellows, had to be secured before the other work could be continued. And that took time.

For the next five or six days Thornton, Williams, and Kelly hunted for rabbits. They built deadfalls, and utilizing sinews that Oomak had cut with a bit of obsidian from the three rabbits Thornton had caught earlier, they made snares. They even killed a few of the little animals with rocks. These they turned over to Oomak. He skinned them with obsidian knives. He dried the skins on bent willow branches. He prepared still other sinews for still more snares. The skins were dried, smoked, scraped and crudely tanned with water and pounded willow bark, and finally Oomak began to sew them together with needles made of fish bones and with sinews he had prepared for the purpose.

Devoting their entire time, as they did, to catching and killing rabbits, the three hunters brought in skins by the dozen, and soon by the score. And they needed to, for Oomak required forty skins for a costume. Still, at the end of the fifth day the Aleut gazed about at the collection of skins and agreed that no more were required.

The costumes were not beautiful, for Oomak made them with fur turned in. But they were comfortable and warm—almost too warm for all save Parker, whose activities were limited almost wholly to watching the blaze. In addition, sandals made of rabbit skin with the fur turned in, and with pieces of bark for the soles, made it possible for the whole group to wander about more or less heedless of stones.

The food problem simplified itself. Practice increased their skill in hunting ptarmigans, which they chased across the rocks and killed with clubs. Oomak now had a spear tipped with obsidian, and with this he caught fish in the stream. Rabbit

meat became excessively plentiful, and Oomak, in what few spare moments he had, dried it and smoked it, and made supports of branches from which the meat was hung. Obviously they would not starve, but could they, with no more to aid them than they had, supply themselves with metal and so make the huge step from the Stone Age to the Age of Iron?

It was not until they had dressed themselves in the rabbit skin clothing that they finally went to work, once more, on the blast furnace. The stone chimney, which was the furnace, already had been completed, and now it remained only to construct the bellows. Thornton recalled having seen pictures of bellows used for smelting by the natives of Africa, and set about to duplicate those simple affairs. They brought clay from the stream, dumped it on the ground about the furnace, and molded it into half a dozen heavy, bowl-like contrivances, with thick walls six or eight inches high. They

punched two holes through the walls of each of these bowls—one on the side toward the furnace, where they made a clay pipe by covering a round stick with clay and then withdrawing the stick. This pipe led to the wall of the furnace where a hole through the stones allowed the pipe to pass. The second hole was somewhat larger, and merely led through the wall of the bowl, being covered on the inside by a flap of rabbit skin, one edge of which was pegged to the wall by twigs. Across the top of each of the bowls, which was hardly more than a foot wide, a loose covering of rabbit skin was fastened. By alternately lifting and pressing down on this loose covering, the air was drawn through the rabbit skin valve and expelled through the clay pipe into the furnace six inches above the bottom of the stone wall.

"**Y**OU amuse me," announced Parker as he stood idly by, watching Thornton pumping away at the first of the bellows to be completed. "You can't get pressure enough with such a contrivance to melt butter, much less ore."

"You don't need much pressure for a furnace only five feet high," replied Thornton, in as conciliatory tone as he could assume. "I'll bet we can make it work."

"Hmph," grunted Parker. "What fuel will you use?"

"Charcoal would be fine," replied Thornton, "but I'm not sure I know how to make it. So we may have to use wood."

"You can't use wood," objected Parker. "It won't work. You'll have to make charcoal. It is not difficult."

"How does one go about it?"

"Perfectly simple," explained Parker. "I've often seen it made by the crudest possible method, and I've made it myself in laboratories. One method I have seen used in Europe, and which dates back to a very remote period, consists in piling billets of wood on their ends to form a conical pile, openings being left at the bottom to admit air, with a central shaft to serve as a flue. The whole is covered with turf or moistened soil. The firing is begun at the bottom of the flue, and gradually spreads outward and upward. The success of the operation—both as to the intrinsic value of the product and its amount—depends upon the rate of combustion. Wood becomes brown at 220 degrees Centigrade. Charcoal made at 300 degrees inflames readily at 380, but if it is made at a higher temperature it does not fire until heated to about 700 degrees. Therefore, for use in smelt-

(Continued on page 110)

Next Month!

FIRE-SHY

By

EDMUND M. LITTELL

Those of you who enjoyed "Midge" in our March issue will be thrilled by this new short story by the same author. You'll recognize some of the same steel-hardened, lovable characters in new and tensely dramatic situations.



"You don't need much air pressure for a blast furnace only five feet high," said Thornton, as he pumped away at the first rabbit skin bellows completed

New Wings for Your Voice

How improvements in telephony, telegraphy, radio and other mechanical methods of transmitting ideas are adding convenience and safety to modern life

By ROBERT E. MARTIN

STAND by!" Something is wrong in the submarine's whirring interior. Despite rapid-fire orders and skilful maneuvers, the nose of the steel porpoise slowly settles, until it points straight to the depths, and only the tip of her tail remains above the waves.

Twenty-eight seamen, fighting for their lives, forge the first link of the chain of communication with the outer and upper world. A floating buoy is released, carrying an electric bell which rings loudly and continuously through the long hours of the day and the following night. At last a steamer is attracted by the sounding bell in mid-Atlantic; tapping on the hull reveals life within, and soon a hole is drilled through the steel, admitting a current of compressed air which clears the stifling interior of the under-sea boat.

Now urgent SOS signals spread through the ether, hour after hour. At last a schoolboy catches the call, relays it to the Naval station. Instantly the Navy springs into action—telephone and telegraph vibrate with orders. From the bridges of destroyers signals pass to engine rooms, human voices command and respond, communication is made through a telephone attached to the buoy, and a few hours later twenty-eight weak sailors of the depths emerge through a rough-burned hole to air, sunlight and life.

THIS actual experience of the U. S. submarine *S-5* is a striking instance of how effectively human ingenuity has established communication between the minds of men. Today the waves of radio, sound, light and electricity, laden with messages intelligible to the human senses, surge across the air, the sea and the land, linking continents together.

Today, by telephone, from virtually any state in the Union, you may call up any station in England, Scotland or Wales; and in one-fiftieth of a second your voice will be carried over 3500 miles of land and sea to the listeners' home. Your photograph can be sent miles

through the air and, at its destination, almost perfectly reproduced. Pictures, drawings and written documents can be hurled across the Atlantic by means of radio or across the continent by telephone or telegraph wire.

And these wonders are only samples of what the future holds. In England, for example, only the other day, an image of a moving model was sent nine miles by radio, with reproduction clear enough to indicate eventual success of television.

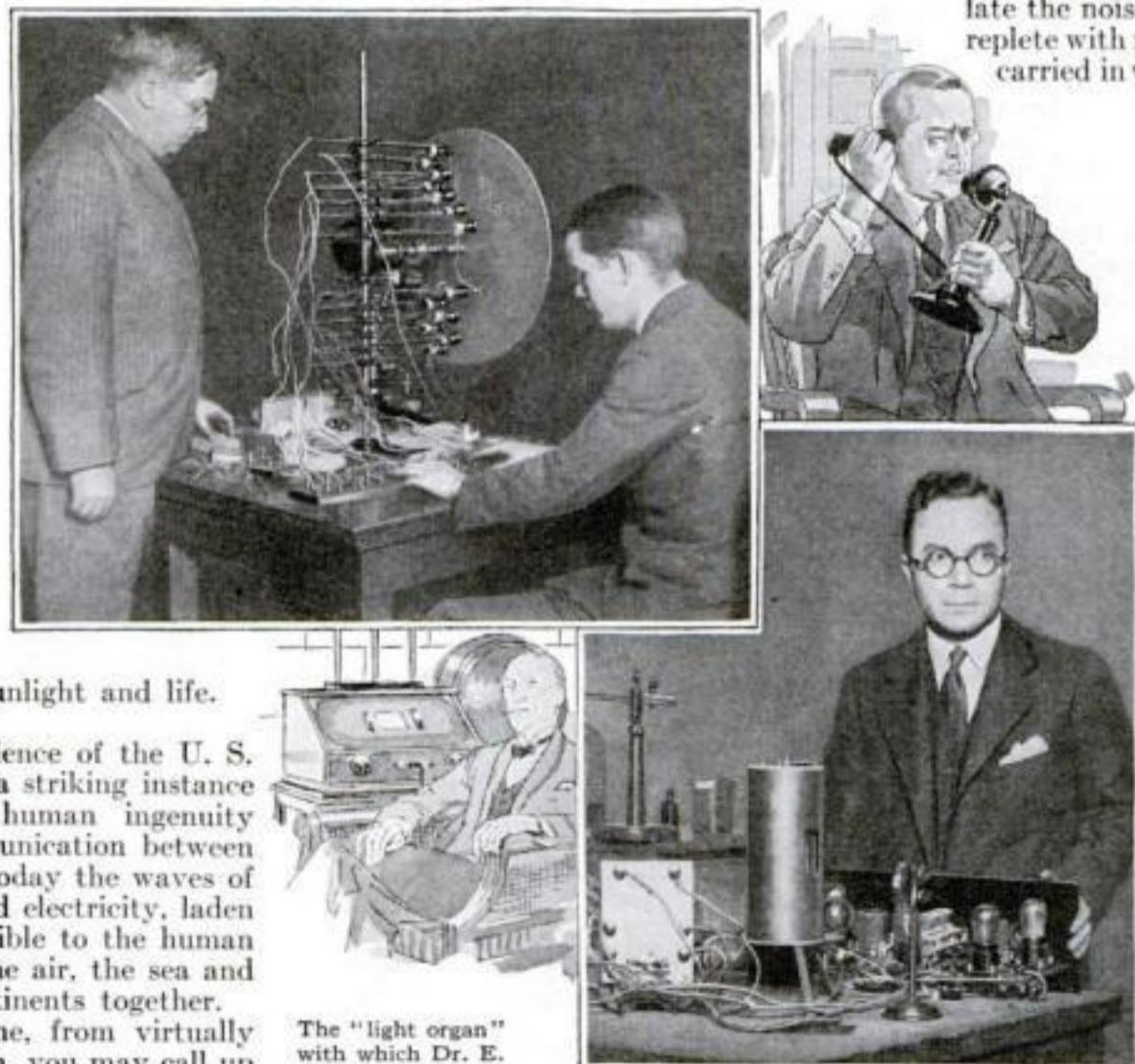
Again, beams of "invisible light," ultra-violet rays which human eyes cannot see, were used recently as carrier waves for motion pictures in an unusual experiment performed by Dr. Donald C. Stockberger of the Massachusetts Institute of Technology. Thrown on a special screen, the pictures glowed with a pale, greenish light. Over these same invisible rays music has been broadcast

and received with an ordinary radio set. They may be used eventually, Dr. Stockberger says, for glareless automobile headlights. The projected rays from apparently unlighted lamps would cause roads and fences painted with fluorescent substances to glow weirdly.

It seems almost incredible that such mastery of the secrets of vibration, bringing a new era of communication, should have been accomplished almost within our own lifetimes; especially when you consider that for thousands of years men have been endeavoring to develop better ways of transmitting their ideas to others. Nature began the process by placing in the human throat a sound-producing instrument, and in the human head two sound-receiving instruments. First man learned to vibrate at will the pair of muscular, reedlike ledges, producing a guttural noise. Then, with lips, nose, throat and tongue, he learned to modulate the noise into sound vibrations replete with meaning. These sounds, carried in waves through air or even a solid substance such as wire or wood, impressed themselves on the ears of others, and through nerves and brain were converted into more or less equivalent ideas.

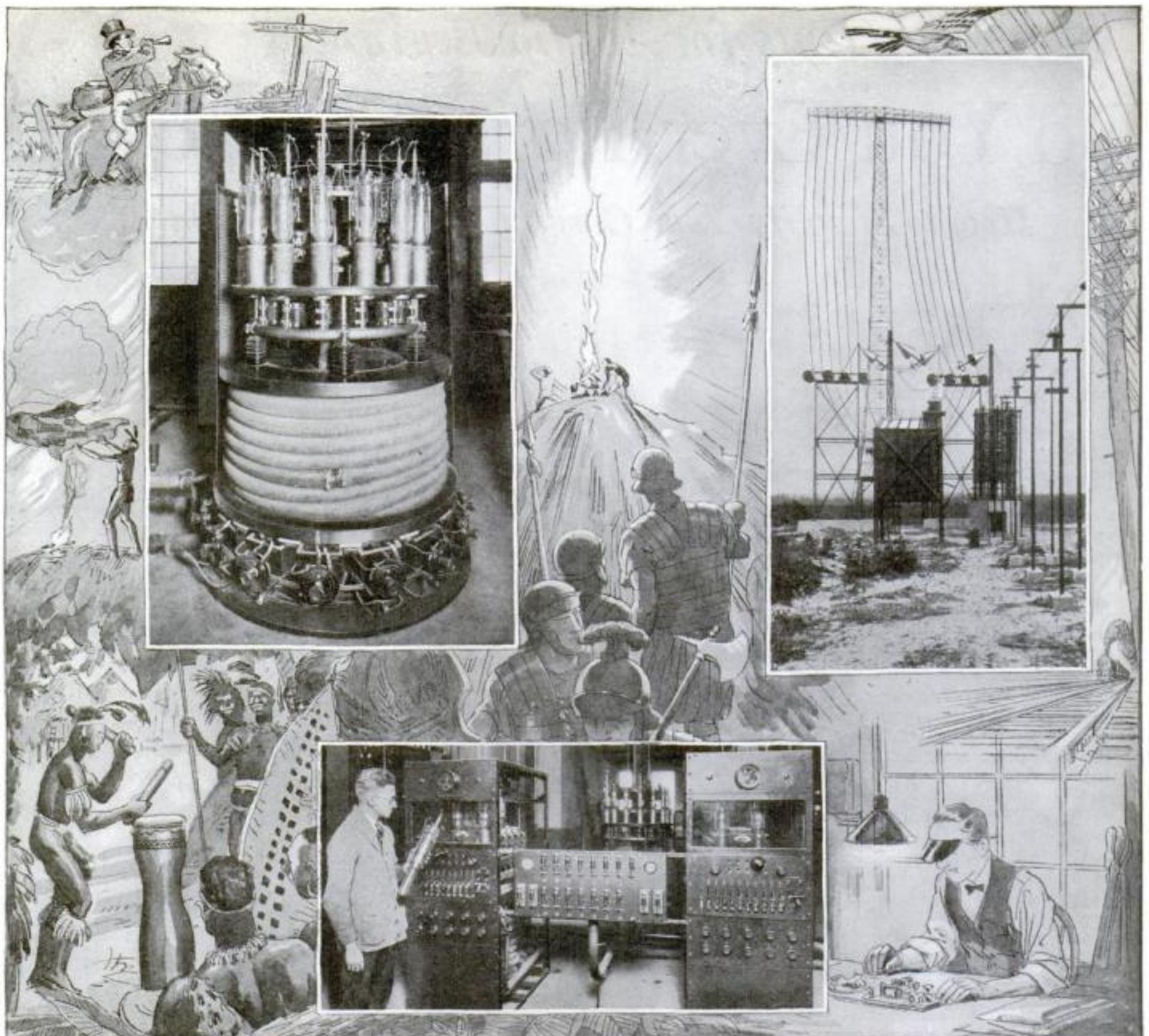
BUT man's struggle for existence soon required an extension of this mouth-to-ear communication of words and thoughts. He learned to relay the call to arms over hundreds of miles by deep-toned war drums. Centuries ago light waves were found useful for signals, by heliograph and beacon fires. The signal hills of the Romans, some of which were artificial, may still be seen to this day.

With the diffusion of knowledge that followed the invention of type printing came the demand for more



The "light organ" with which Dr. E. E. Free (left), and Dr. Norman Hilberry play tunes by directing light waves of various intensities on a photo-electric cell

Dr. D. C. Stockberger of the Massachusetts Institute of Technology, conducting his experiment in which music was conveyed on invisible rays and made audible by means of a radio set, by causing them to fall on a photo-electric cell substituted for detector



War drums, beacon fires, post riders—all these were but a prelude to our modern marvels of communication—the latest of all, telephoning from America to England, in .018 of a second! The three photos show the main links in this artificial "voice bridge." From the main control board at Rocky Point, L. I. (center), the voice speeds across the ocean from the aerial (right). At left, battery of powerful transmitting tubes

rapid exchange of ideas. Within the last century communication has been revolutionized. It was only yesterday in history that post riders and Paul Revere carried messages over the countryside. It is only ninety years since Morse created the telegraph, and only sixty-nine since Cyrus W. Field tied two continents together with his cable under the Atlantic.

From the sending of signals by electric wires it was a short step to Bell's telephone. And then men conceived the idea that electric waves, as well as sound, could be sent across the air. The nineteenth century was just coming to an end when Marconi, from a liner sixty miles at sea, sent through the ether his famous code message. Two years later, wireless code signals spanned the Atlantic.

And now—latest marvel of all—with trans-Atlantic telephone you may converse with your friends across one seventh of the earth's circumference, although as yet there are a number of limitations. For one thing, such a

conversation will cost you at the rate of \$25 a minute! A recent twenty-eight-minute "gossip" between two women, one in New York, the other in London, cost them \$700; while in one six-minute call, a London business man held eight conferences with American associates for \$150.

MEANWHILE a thousand improvements in wired telephone and telegraph have made distant communication almost as simple a matter as face-to-face conversation. For instance, when you send your voice over miles of wire, instead of becoming "tired" and weak on the journey, it is strengthened every mile or so by a tiny "loading coil," which revives the electric currents and sends them on their way with renewed energy. For long distance conversation, "repeating stations" every hundred miles or so serve as relays.

Moreover, five separate conversations now can be carried over a single circuit, by means of high-frequency currents.

Even more amazing are the "mechanical brains" and electric fingers at the central exchange, which receive your call and automatically connect you with one party out of tens of thousands.

One of our great railway systems, of 12,000 miles, now is operated entirely by the voice of the telephone. In large stations the stentorian voice of the announcer is replaced by loudspeakers. At a single tower in the Grand Central Terminal in New York, Bell and automatic telephones convey orders; the telautograph transmits written schedules; loud speaking telephones, lamp signals, bell annunciators, selector telephones and similar devices enable the public to travel safely, quickly and cheaply.

The telegraph, too, has grown far afield. With the new metal permalloy, one hundred times as responsive to magnetism as the softest iron and six times as fast in transmission, we save much of the metal formerly needed for cables. Our underwater electric spider-webs today

(Continued on page 138)

Hints for Radio Beginners

Do You Ever Forget Switches?

How to Simplify Your Current Control—Other Ideas

TURNING on and off the filament switch on your radio receiver is all that is necessary to put the set into operation and stop it again if it is run with a storage battery to light the filaments of the tubes and with dry cells to supply the B-battery current.

The introduction of trickle chargers and B-eliminators, however, has complicated the problem. Unless you buy an automatic relay switch to take care of turning on and off both the trickle charger and the B-eliminator, you will have at least three switches to throw every time you put the set into operation or stop it. And if you occasionally forget to turn on the trickle charger when you get through using the set, the A-battery will soon become discharged.

The diagram on this page will show you how to rig up a switch that will do all the necessary switching with one throw of the lever.

You will note that when this switch is thrown to the left, the filament current to the set is cut off and the connection to the B-eliminator also is broken, while the current is turned on to the trickle charger.

Even if you have to purchase the switch and sockets, the cost of this current control switch will be low. The switch and sockets can be mounted on the under side of the radio table.

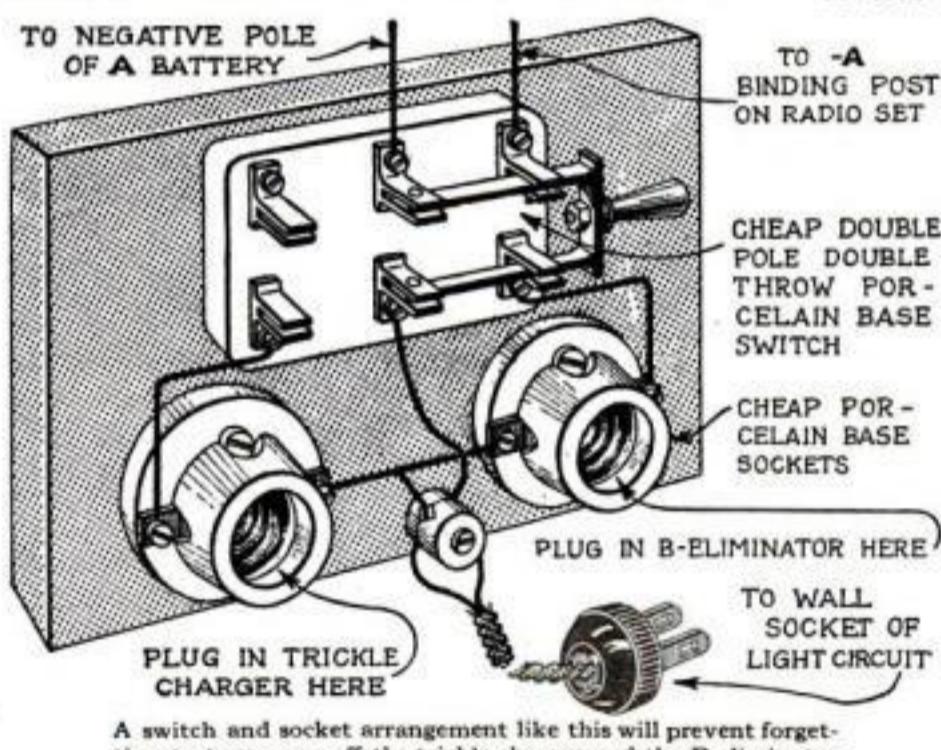
Testing B-Eliminators

DON'T try to test the voltage developed by a B-battery eliminator with an ordinary type of voltmeter. It is impossible to get even approximately accurate results in this way, and you may fool yourself into believing that the detector and amplifier stages of your radio set are getting the proper voltages when the pressure actually may be far too high. The reason for this is that the voltage developed at any binding post on a B-eliminator of the conventional type depends on how much current is being drawn from the eliminator.

If you connect up a voltmeter to a B-eliminator while it is being used to operate a set, you will notice an immediate falling off in the volume. This will be due to the drop in voltage caused by the flow of current through the volt-



Test your battery occasionally to see if your trickle charger is keeping it in good condition



meter. If, on the other hand, you attempt to test the B-eliminator voltage while the radio set is disconnected from the eliminator, the voltage will read too high.

A B C's of R A D I O

THE old method of reducing volume of a radio set was to cut out the last stage of audio amplification; and consequently most old style sets were provided with jacks, so that you could plug the loudspeaker into either the first or second stage as required. The development of special power tubes for use in the last stage has changed all this, so that the best practice now is to keep all the

tubes in the audio amplifier end of the set working at all times and to control the strength of the signal before it is fed into the audio amplifier.

There are several ways of doing this, perhaps the simplest being a rheostat control of one or more of the radio-frequency amplifier tubes. Practically no loss in the quality of the signals received is noted when this type of control is used.

Special meters suitable for testing the voltage of B-eliminators are available, but they are rather expensive. To adjust your B-eliminator, first make sure that you have the correct C-voltage.

Test Battery Frequently

THE popularity of the trickle charger, either as a separate piece of apparatus or as combined with a low capacity storage battery in the form of an A-power unit, has had an effect on the amount of testing that is needed to make sure that the storage battery is charged sufficiently. Instead of having to test the battery once every week or two, as is required when you charge the battery with a full rate charger, you need test the battery only often enough to make sure that the trickle charger is keeping the battery in a sufficiently charged condition.

It is desirable that the battery be tested every two or three days after it is first installed, and if you find, after several days or a week of use, that it is still fully charged, you can be sure that the current put in by the trickle charger more than balances the amount used up by the set.

A floating ball type of hydrometer is excellent for such tests because it can be read so easily.

Grid Leak Affects Tone

NOW that the grid condensers used in most radio sets are so carefully made that there is practically no leakage of current directly through the condenser itself, radio fans are in a position to determine the effect, on both quality and volume, of changing the grid leak.

When you are using a tube of the 201A type, you will find that distant weak signals come in with greatest volume if you use a grid leak of very high resistance. From five to nine megohms is about right if you want to get the last mile of distance.

On the other hand, a high resistance grid leak is not so good on powerful local signals. Distortion spoils the quality as soon as the volume approaches even a medium high level.

For best results on powerful local signals, use a grid leak of about one half megohm. The detector tube will stand a lot more volume without overloading.

How Broadcasting is Improving

Better Transmission and Station Chains to Do Much for Programs

By.

GEORGE LEE DOWD, JR.

Conceal all apparatus!—is the studio watchword. Note how the microphones (left) are hidden in an ornamental globe



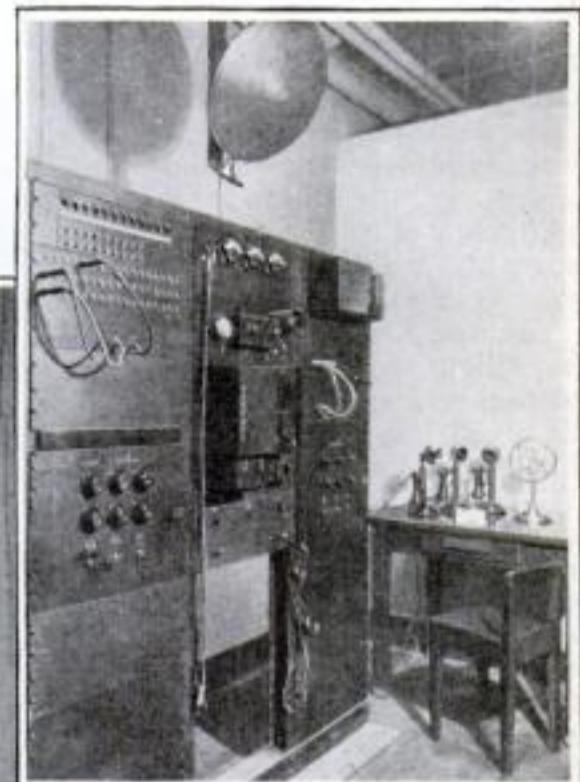
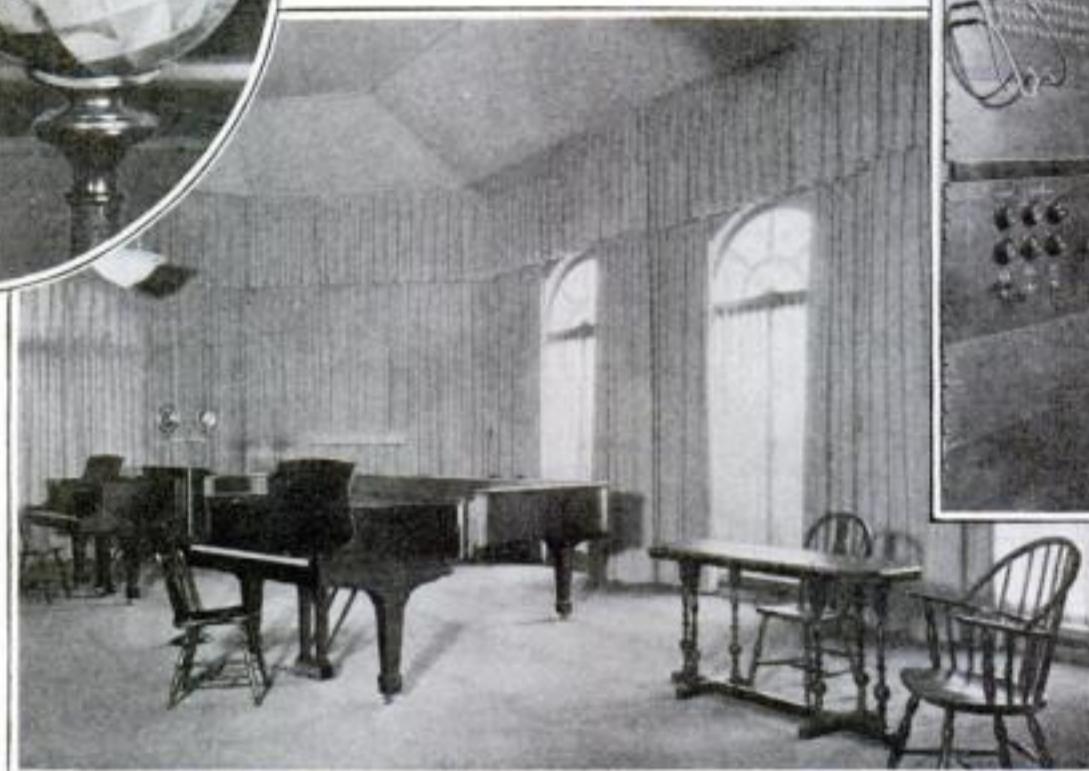
EVERWHERE engineers, broadcast directors and others are working on plans to improve the quality of radio programs.

Perhaps none is more important to the owner of a radio set than those which have resulted in the improved quality of broadcast music. Also, the widespread public acceptance of radio and the intense competition between the various broadcasting stations have resulted in constantly improved programs.

Radio broadcasting has long since passed out of the experimental stage. Today the transmitting room of any large broadcasting station conveys a definite impression of solidity and permanence. The modern radio transmitter really is a specialized type of power house that transforms air vibrations into oscillating electric currents, amplifies them to an almost unbelievable extent, and then sends them out by way of the antenna to millions of listeners. And along with the increase in power and permanence of our broadcasting stations, there has been a vast improvement in the faithfulness with which the music and voices are put on the air.

This improvement in quality is most noticeable, perhaps, in the programs that are picked up by microphones at some distance from the broadcasting studio, largely because there has been more room for improvement in this type of broadcasting.

EARLY attempts to broadcast acts or scenes of musical comedy and opera productions direct from the stage produced weird results. If the tenor, for instance, happened to be near the microphone, his voice came through with a power that caused the loudspeaker to go off into a nerve-shattering rattle; while the voice of the soprano standing on the



(Left) Commodious new studio of WABC, designed to give proper resonance to make broadcasting lifelike. The control room of the station is pictured above

other side of the stage resembled the feeble chirps of a canary.

What we may expect along these lines in the future was strikingly demonstrated recently when the chain of stations headed by WEAF and WJZ broadcast the famous "Garden Scene" from the opera "Faust" direct from the stage of a Chicago opera house. Listeners were

amazed at the fidelity of every part of the musical reproduction.

Fay Leone Faurote, general manager of station WABC, recently expressed the opinion that because of the improvement in the quality of the tones reproduced, the day of freak stunts in radio is over.

"In the early days of broadcasting," he said, "it was a job to fill our program. All sorts of novelties and freak stunts were put on to vary the monotony of a program made up largely of phonograph records.

"IN THOSE days, only a few years ago, nobody worried much about echoes or resonance, because the transmission was poor anyway. Then better microphones came into use. Modulation was vastly improved. In order to eliminate echoes and resonance, engineers fitted studios with so much sound absorbing drapery that the transmitted music was dead and lifeless, but I expect to see a considerable improvement along these lines in the future. We have found that a certain amount of resonance is desirable. It adds naturalness to the tone quality of the music or the human voice. In fact, our new studio was designed with that point in mind."

In large measure, the steady improvement in the quality of programs is due to the fact that advertising is footing the bill. And the broadcasting stations, in striving to get the business of the advertisers, have come to realize that listeners won't follow an evening's program, even with one or two high grade features sponsored



The oscillograph at WJZ, which permits the engineer in charge to study the modulation and gives visible evidence of incorrect adjustment

by advertisers, if the rest of the program isn't worth listening to.

"We have been practically forced," said the manager of a prominent Eastern station, "to contract for high grade features that we pay for ourselves so that our advertisers will feel that they are in good company."

OTHER stations accomplish the same result by employing, as staff artists, entertainers of such exceptional ability that the studio staff is capable of putting on a program equaling the special features in quality.

You and I and the rest of the millions of radio broadcast listeners get the benefit of all this dazzling array of talent without a cent of expense. Many readers of POPULAR SCIENCE MONTHLY, however, have expressed a fear that the rapid development of the chain station idea—whereby the actual performance before the microphone is sent out by wire lines to many other stations so that all the stations transmit the same program simultaneously—will not work out well for several reasons.

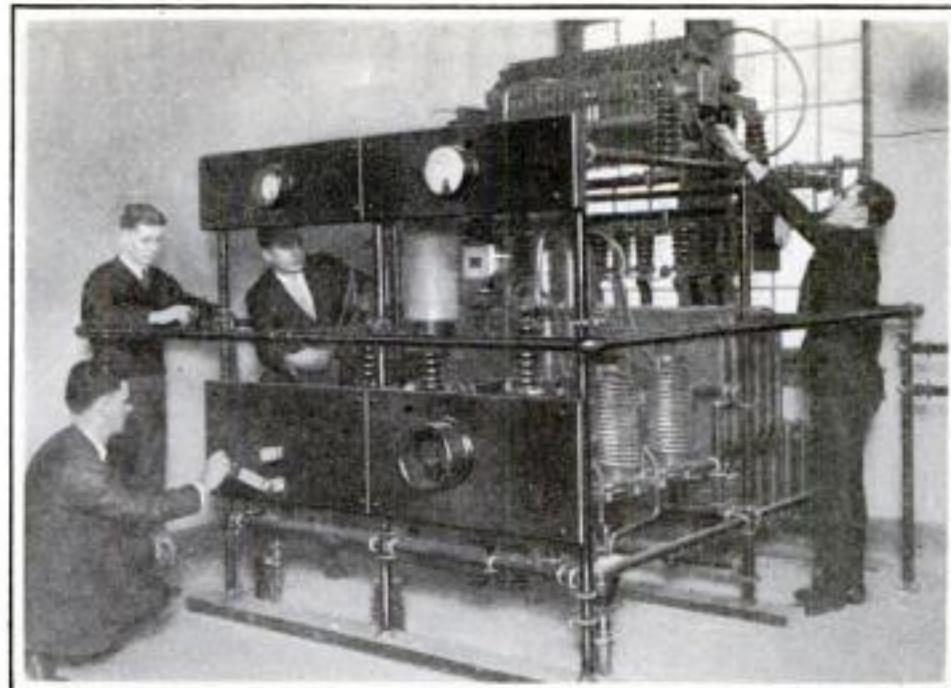
"Suppose we don't happen to like the particular program the chain stations are broadcasting, what then?"

writes one reader. There would be cause for worry on this subject if the Government controlled broadcasting and if the programs were paid for out of license fees extracted from the listeners, as is the system in many foreign countries.

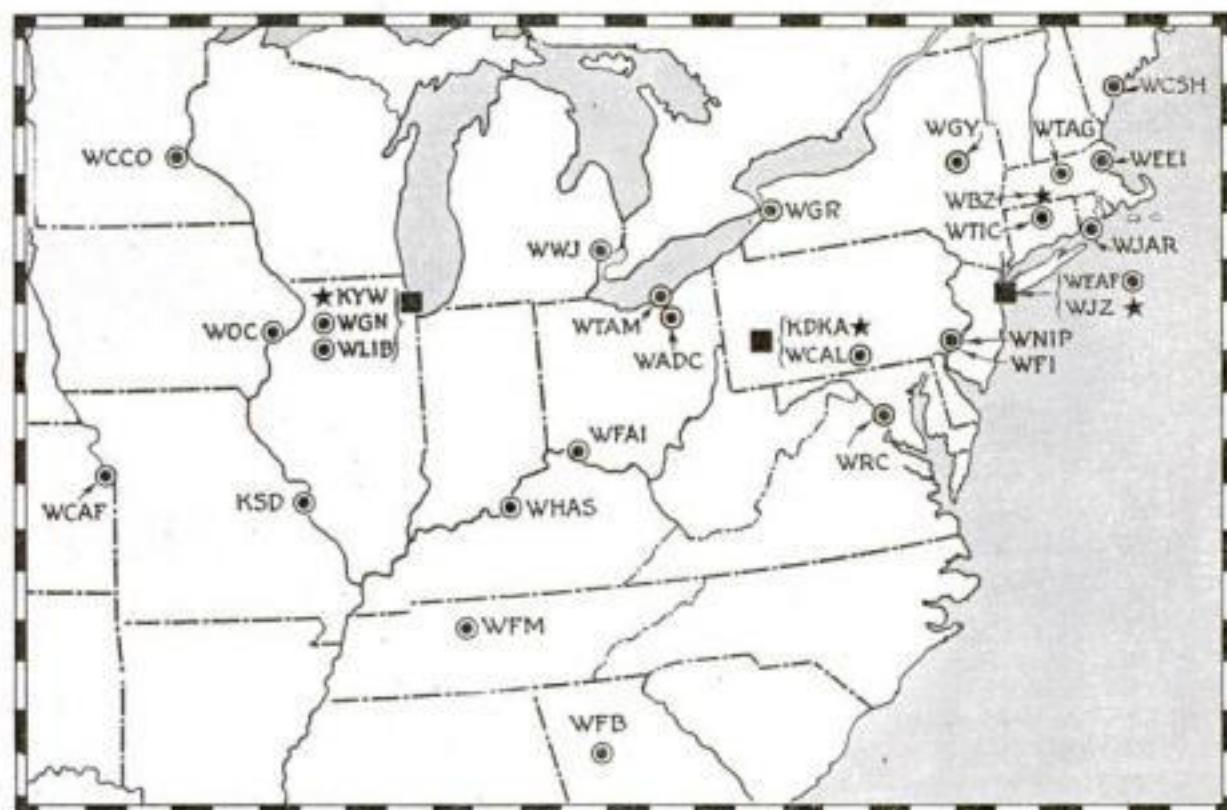
But such a situation will not arise in this country, for reasons that appear at once when you study the requirements of the advertisers who pay for the programs. An advertiser who sells his products all over the country naturally wants to build up good will by means of a chain of stations that will reach as many people as possible. But there are other advertisers who want to reach just one section.

THE big chains of stations, headed by WEAF and WJZ, will take care of the first group, while stations like WABC in New York and similar stations in other localities will supply the demand for broadcasting in a specified area.

Improvement is also promised in the broadcasting of all special features not considered part of the regular program. Verbal reports of sporting events, for example, will be much clearer owing to improved methods of picking up such features and transmitting them to the main broadcasting studio.

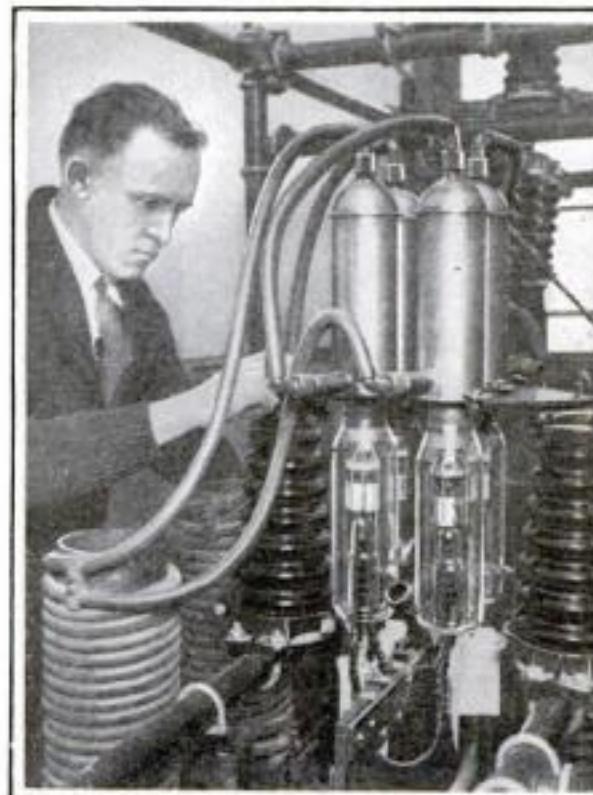


This modern, high-power transmitter, in one of our large broadcasting stations, gives an impression of solidity and permanence



Development of simultaneous broadcasting by a chain of stations assures good programs to everyone. The chain headed by WJZ is represented by stars; that headed by WEAF by dotted circles. Ultimately every section of the country will be served by these chains

Early attempts at broadcasting prize fights or football games, for instance, were marred by the shouts of the fans surround-



Present-day stations are really special purpose power houses. Batteries of vacuum tubes supply the radio-frequency energy

ing the announcer to such an extent that his words were lost completely at vital moments. In future, we are promised, the applause and shouting will be present as a background for the announcer's voice, but will not be allowed to interfere with the clarity of his words.

The development of the chains of stations will certainly help the broadcasting of outstanding events such as a speech by the President of the United States, because with so many stations transmitting the speech you will be sure to get it clearly from at least one station.

As far as exceptional features are concerned, prominent advertisers are combing the country for high priced opera stars, great musicians and other entertainers, and promise steady improvement in the quality of their offerings.

MUCH has been said and written about short wave transmission and its possible effect on broadcasting and the sets now in use. I talked this matter over with Alfred H. Grebe, who has experimented extensively with this type of broadcasting.

"I don't think there is a chance that broadcasting will, in the near future, be changed to the short waves," he said. "At least not until some apparently insurmountable difficulties are worked out. In the first place, none of the millions of radio sets in use today can tune-in the very short waves; in the second place, short wave transmission has at least one peculiarity that renders it unfit to use for regular broadcasting.

RADIO waves of from twenty to forty meters' wave length carry marvelous distances, but they seem to pass over a large section of the country immediately surrounding the transmitter, so that listeners only a few miles away may not hear anything, while other listeners hundreds or even thousands of miles away may hear the program with great volume. There wouldn't be much use in transmission like that except for special purposes.

"Of course we expect to continue to use our mobile stations transmitting on waves lower than the regular broadcasting range, to bring special features into the studio whenever it is not possible to get a regular wire connection. For instance, a description of a yacht race by an observer located within a stone's throw of the boats is made possible in this way."



With 700 radio stations now on the air, with wave lengths available for only a fraction of that number, Uncle Sam is just waking up

Don't Blame Your Radio Set!

Why You Get Several Stations at Once

By ALFRED P. LANE

IN THE last few months hundreds of readers have written to POPULAR SCIENCE MONTHLY complaining about the poor results they are getting from their radio sets, and asking for suggestions to help them improve their reception. They want to know, in particular, what causes the terrific whistling noises that they hear and why they are unable to separate the different stations.

A letter from a reader in Chicago is typical. He writes:

"I wish you would tell me what is the matter with my radio set. Last winter I got fine reception. I could tune-in a large number of distant stations on any good night, and when the static was light I got them as clear as a bell. But something must have happened to my set, because this year I find it almost impossible to get any distant stations without a most unpleasant whistling noise. The whistle wavers slightly in tone but keeps up no matter what I do in the way of changing tubes, buying fresh batteries and looking over connections."

"Lately the whistling noise has started on some of the powerful local stations, and in some cases it's so bad that it spoils the music. Besides this trouble, my set doesn't seem to be selective any more. Two and sometimes three stations come in all jumbled up together like boarding house hash. Please tell me what to do about it."

It's a hundred to one shot that nothing is wrong with his set. Probably it is just as good as it ever was. The trouble is that there are far too many broadcast stations on the air.

PRESIDENT COOLIDGE, in his annual message to Congress, summed up the situation in a nutshell. He stated:

"Due to the decisions of the courts, the authority of the Department [of Commerce] under the law of 1912 has broken down; many more stations have been operating than can be accommodated within the limited number of wave lengths available; further stations are in course of construction; many stations have departed from the scheme of alloca-

tion set down by the Department, and the whole service of this most important public function has drifted into such chaos as seems likely, if not remedied, to destroy its great value. I most urgently recommend that this legislation should be speedily enacted."

Meanwhile radio broadcasting is going from bad to worse, and will continue to do so until some definite action is taken. When the President spoke, there were slightly more than 600 stations on the air. As this is written the number has increased to about 700. Each new station means just so much more squealing and howling and interference for thousands of radio fans.

The reason for the long delay from the legislative standpoint has been: To whom should the control of radio broadcasting be awarded?

ONE group has held that radio should be under the jurisdiction of the Secretary of Commerce. Its opponents have contended that a commission form of control is preferable. This has been the chief obstacle to the clarifying of the radio situation, in spite of the fact that there are other knotty problems which must be solved either now or in the near future if broadcasting is to be permitted to develop along lines that will bring the greatest amount of pleasure to the largest number of radio listeners.

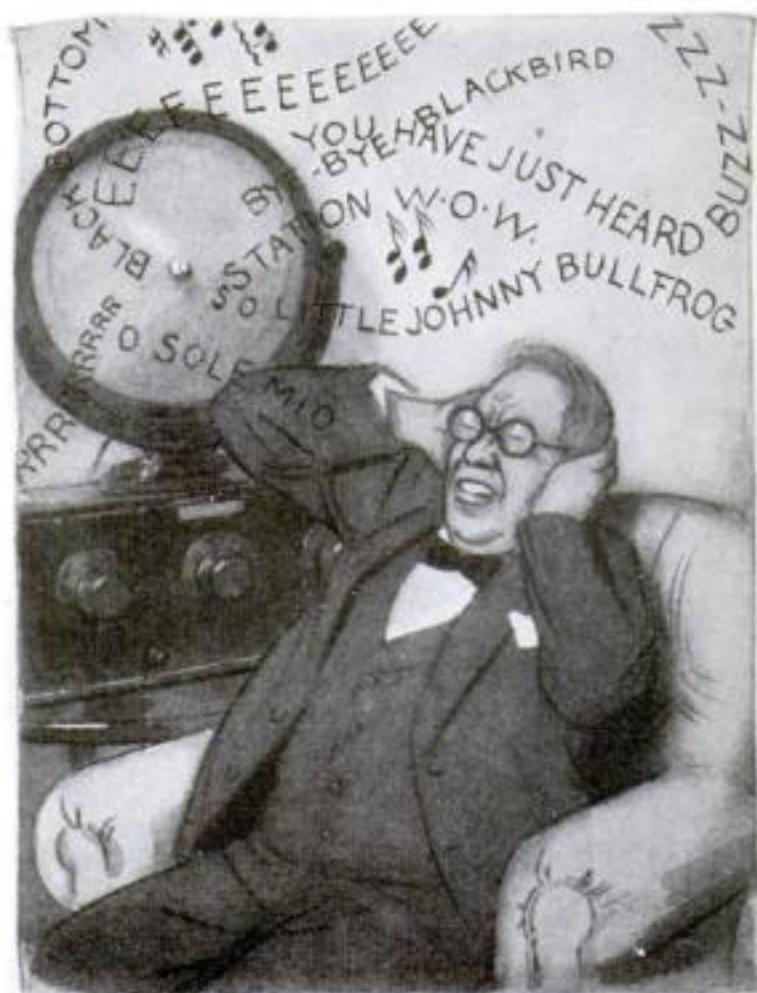
Listening-in for just one evening will prove to anyone that there are too many stations on the air. But what is to be done about it? Who is to say that this station is necessary and that one superfluous? How are the unneeded stations to be denied the privileges of the air? Answering these questions will require much hard thinking on the part of our legislators, especially since

radio broadcasting offers legal problems for which there are no precedents.

But after all, what you as a radio listener want to see is the air cleaned up so that you can sit down before your radio set in the evening and get clear music and speech from several different stations without having your radio entertainment ruined by howling interference.

Unfortunately, there is nothing that you can do to your radio equipment that will help in the slightest degree to overcome the troubles brought on by too much broadcasting. Even a laboratory model receiver built by the most skilful radio engineer could not unscramble the stations from the mess of heterodyne interference that is daily becoming worse.

As we go to *(Continued on page 127)*



With too many stations on the air at once, this is what happens to most of us. What remedy will be applied?

I Catch My Wild

By



Wynant Davis Hubbard

For several years Wynant Davis Hubbard, a former Harvard football player, hunted wild animals in Africa, not to kill them, but to capture them alive, train them, and ship them to American zoos. His amazing experiences, some of which he relates here, are stranger than romance, more exciting than bronchobusting. The ordinary African game killing expedition seems tame compared with the adventures of this lariat-thrower of the jungles.

But I wasn't particularly confident. In several years of adventure over more than five thousand miles of South Central Africa, I had hunted and captured plenty of big game alive, but never before had I tackled a snake the size of this one. Naturally I was somewhat doubtful how to go about it. I had heard of men noosing pythons, but such a method seemed unnecessarily dangerous. For I knew that while a python can inflict a severe bite, its most deadly weapon is its tail. With this it can strike a blow that will snap a man's legs as if they were matchsticks. Thus, while noosing the snake's head undoubtedly would prevent its escape, it would also leave fifteen to thirty feet of writhing muscle lashing around furiously at the end of the rope.

"We've got to get it by the tail," I thought. And immediately a plan suggested itself. Why not use forked sticks, the most reliable catching implements any hunter can have? Quickly my native boys cut four heavy sticks about five feet long and deeply forked at one end; also a long light pole with which to poke the snake. Then I outlined the plan of attack.

"MANGINEERA, Kaputang and Towl," I said, "each of you take one stick—give me one, too. Now, I will push the snake with the pole and try to make it straighten out and move away. If it does, we four will approach quietly, and when I shout we will pin the snake down with the forked sticks. I will take the tail. MANGINEERA, you take the head. Kaputang and Towl will be between. Do you understand?"

"Yes, Inkos," they answered.

Sable antelope calf, caught young, shown with Mrs. Hubbard. Trusting and friendly, these animals are very easy to raise. Full-grown, they have horns measuring fifty inches, with which, lying down, they defend themselves from attack



I turned to Mangineera, my faithful pigmy gun bearer and adviser.

"Mangineera," I said, "we certainly can't catch this snake when it is coiled up like that. Do you think we'll have a chance if we tease it and make it stretch out?"

"Maybe, Inkos," he said.



If a full-grown leopard got loose and climbed, snarling and growling, on top of the monkey cage, how would you catch him? Mr. and Mrs. Hubbard took hold of his tail—but it was a perilous ten minutes before they managed to slip his collar on! Bosco, a half-grown leopard, is shown here purring contentedly under Mrs. Hubbard's caresses.

Center, above: Skillum, the leopard used as a family pet, being sprayed to rid him of fleas



In this picture, showing Mr. and Mrs. Hubbard and their two children, the explorer is riding Yank, the six-year-old elephant whose thrilling chase and capture by the tail are described in the article.

Beasts by the Tail!

Some Glorious Free-for-Alls I Have Had in the Jungle with Man-Crushing Pythons, Elephants and Wild Boars

"But be careful," I cautioned. "Don't touch the snake until I say the word. You other boys," I said, turning to the rest of my helpers, "stay close in case something happens."

Approaching within four feet of the coiled mass, quietly so as not to alarm it, I poked it gently with the long pole. If it had lunged at me, I would have had to run. But luck was with us, for the big brute slowly uncoiled and straightened out as it prepared obligingly to crawl away!

"Come on, Mangineera. Gently now. Watch its head, boy." I was almost whispering my directions. All three boys were walking stealthily alongside the slowly moving creature.

I got up close to the tail. I could see the entire shimmering length.

"Now!" I shouted.

Down came the four sticks together. The boys grunted as they put their weights to the poles. I pushed with all my strength. The great snake hunched up in bunches between the sticks, trying to free itself.

I CALLED to the other natives, who had been watching open-mouthed. They rushed up and we had eight more clutching the slippery body. Mangineera slid his hand down and found a hold just back of the flat head.

"All right, now," I ordered, "pick it up."

The python must have weighed a hundred pounds. It writhed and buckled; I could feel the powerful back muscles flow under my grip. But finally we managed to stuff it into a huge sack that

one of the boys had brought. Then we tied the bag to a pole and carried our prize back to my main animal catching camp at Tara, Northern Rhodesia. There we took it out and measured it. It was exactly seventeen feet, five inches long!

THIS struggle was typical of countless exciting adventures and narrow escapes which fall to the lot of the professional animal catcher. Catching dangerous animals alive is the most thrilling sport in the world. In my opinion it far outclasses hunting to kill; for it is a game in which human wits and strength are pitted against the power and cunning of wild beasts, with the chances of victory on a fairly even basis.

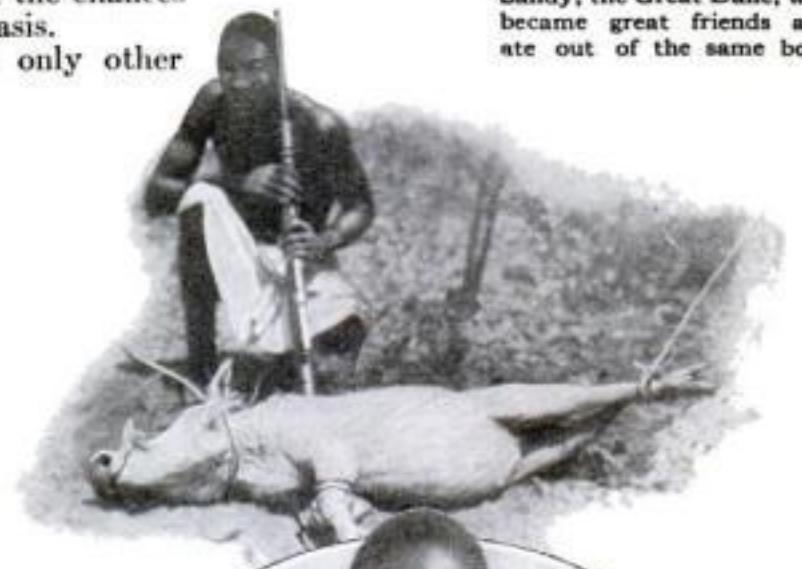
By odd coincidence, the only other python I ever was fortunate enough to capture was found within a week of the first. This time, however, the battle nearly ended disastrously for me. Apparently the snake had just finished its dinner, for about a third down its length was a bulge the size of an antelope. That the victim had been a ram was evidenced by the horns, which projected until they almost punctured the snake's skin.

Again we came down with our forked sticks; but this time I was caught off my guard. Instead of keeping my eyes on the dangerous tail, my attention was

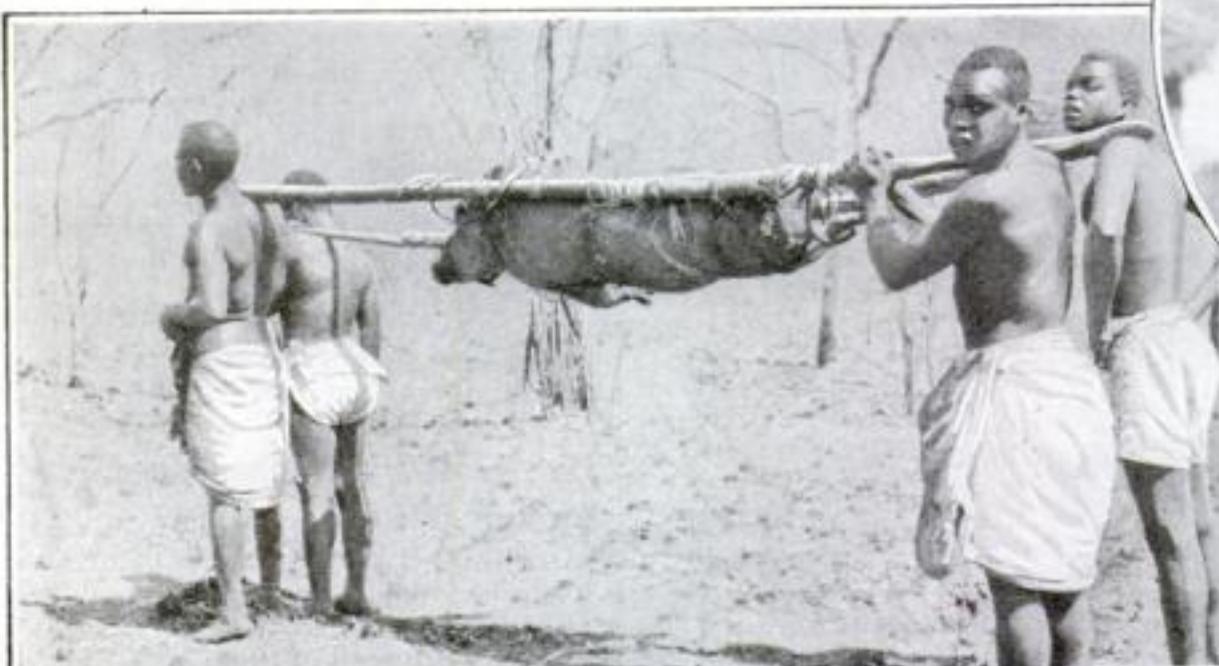
(Continued on page 139)



Wynant D. Hubbard with his family watchdogs—Skillum, the leopard, and Sandy, the Great Dane, who became great friends and ate out of the same bowl



The family cat—a white-tailed mongoose, kept in the Hubbard kitchen after its capture to catch rats and mice, which it does with remarkable success owing to its extraordinarily sharp eyes, agility and lightning speed.



This is the wart hog whose thrilling capture, after an all-day chase under a broiling tropical sun, is described in the article, being carried back to camp. Hubbard caught him, finally, by the leg!

Center, above: A wart hog, so-called because of warty excrescences on its face, trussed and tied after its capture ready to be toted to camp



That teeth furnish startling evidence of man's descent from apes is the contention of Dr. W. K. Gregory, New York anthropologist, shown here with a few of the skulls of apes with which he has made extensive researches

On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our everyday problems.

Food Crops Increased by Science

IMPORTANT new ways of developing larger and better food crops have come to light through recent scientific experiments. For example, Prof. R. B. Harvey of the University Farm, St. Paul, Minn., reports that he has speeded up the ripening of fruits by subjecting them to gas attacks with two ingredients of common city gas, ethylene and propylene. In his experiments, he says, bananas and honeydew melons were found to be especially benefited by the gas treatment.

Other tests by Dr. M. Jacobson, plant physiologist of Camden, N. J., indicate that seeds subjected to mild doses of so-called "soft" X-rays produce greatly increased yields. Potted plants from rayed seeds flowered and bore fruit from one to three weeks earlier than those from unrayed seeds, he reports, and their yield was from fifteen to 170 percent greater. Potatoes from treated tubers gave crop increases of 170 percent.

Scientific breeding of wheat, like the raising of pedigree livestock, also is proving of great value. According to Dr. R. J. Garber of West Virginia University, farmers in the great wheat belt of Canada alone have obtained eighty million more bushels a year since planting an improved variety of wheat.

Guncotton from Garbage

POSSIBLY some day nothing whatever will be wasted. The last word in salvaging scraps comes from Berlin, Germany, where an engineer, Kurt Gerson, has recently erected a large plant to convert the garbage of the city into guncotton, artificial silk, and other useful products.

By his process, all cellulose matter is sifted from the garbage and subjected to special treatment. Moreover, by dis-



Sounds can be "seen" and the deaf can "hear," by means of the "phonoscope," the invention of Joseph W. Legg, New York engineer. The device registers the vibration of the voice by a beam of light and a small revolving mirror. In the picture, Mr. Legg is speaking into the device while Miss E. S. McKay reads the "patterns" made by the vibrations

tilling such matter as potato parings and pieces of wood, Gerson declares he can produce tar, charcoal, and acetic acid.

Voice Secrets Revealed by Camera

THROUGH the magic of photography, experimenters are revealing in black and white new secrets of our voices, and their effects upon listeners. Recently Dr. Carl E. Seashore of the University of Iowa, demonstrating how he makes sound waves appear before him, produced a visible record of a negro "blues" song. He showed that the black and white impression of the sound waves was far more reliable than trained human ears in re-

cording pitch and timbre of the voice.

From sound photographs, Dr. Seashore and others are studying the factors that make singing beautiful and appealing. For example, they have discovered that the quivering vibrato is an important means of portraying emotion in music and speech.

Prof. G. Oscar Russell of Ohio State University recently succeeded for the first time in making photographs of the interior mechanism of the voice. This he achieved with a camera connected with a tube containing mirrors, lenses, prisms and a lighting device.

Now—the Pedigreed Oyster

AFTER many remarkable experiments, William F. Wells, biologist of the New York State Conservation Commission, has succeeded in raising a superior breed of oysters.

The super-oyster is said to be fatter, more tasty, faster-growing and hardier. It lives in a shell of improved design, decorated with a symmetrical pattern, and far different from the clumsy, misshapen home of the ordinary oyster. It is the result of modern scientific breeding methods, such as have produced the paper-shelled pecan, the seedless orange, and countless other improved foods.

He Draws Electricity from Light

ANOTHER step toward realization of the fascinating dream of obtaining power from the sun is seen in the recent success of Dr. W. W. Coblenz of the U. S. Bureau of Standards, Washington, in generating electricity from light through the agency of the mineral molyb-



One of the first tests made in the new altitude chamber of the Bureau of Standards, Washington, was that of the latest Curtiss 375-h.p. airplane motor, equipped with a supercharger for high altitudes. E. W. Hess is shown making final adjustments on the recording apparatus

with Science

denite. This mineral is one of the chief sources of molybdenum, used in steel making.

Dr. Coblenz discovered that a crystal of molybdenite, when exposed to natural light, produces an electric current; in fact, he was able to obtain in this way two ten-thousandths of an ampere of current. Moreover, by using vacuum tube amplifiers, such as are employed in radio, the feeble current may be magnified greatly, making the crystal available as a delicate light detector, or electrical "eye," such as the photo-electric cell.

Old Silk Made into New

WORD comes from Japan that old silk stockings and worn-out silk clothes need no longer be thrown away, but can be turned into new silk of better quality than the original. A few weeks ago Dr. P. P. von Weimarn of the Imperial Research Institute at Osaka completed experiments in which he claims to have made waste into threads of higher quality.

The old silk rags were dissolved, then put through chemical processes which converted them in turn to a liquid, a jelly, and finally to a plastic substance that could be drawn out into threads.

Circles Earth in Sub for Science

MEASUREMENTS which may prove invaluable to science in studying earthquakes and the earth's structure are being computed by Dr. Vening Meinesz, young Dutch scientist, as the result of a remarkable underwater voyage which he recently made around the world in a submarine to measure variations in the force of gravity at different parts of the earth's crust.

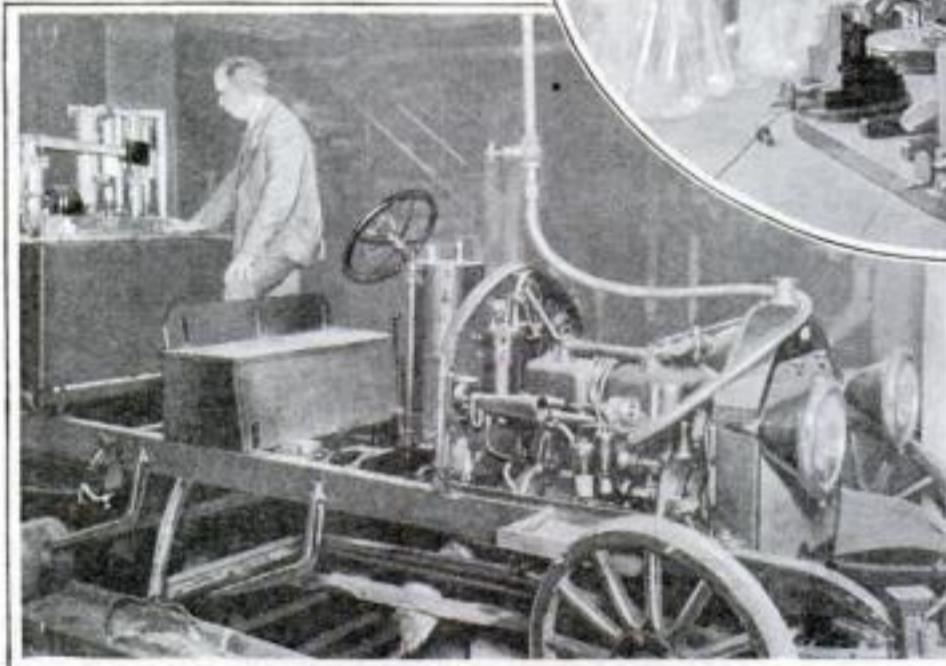
At some points on the earth's surface objects weigh slightly more than at others. These differences, while too small to be detected by ordinary scales, are important to scientists as indicating differences in the density of rocks in the earth's crust. It was because the motion of a surface ship disturbs the apparatus for measuring such variations that Dr. Meinesz carried the apparatus undersea around the world.

Light Rays Source of Life?

IN THE mysterious and highly penetrating cosmic rays which bombard our earth from outer space and which reach us with power to pierce six feet of lead, science may find the source of all life energy. Such, at least, was the fascinating possibility suggested recently by Dr. Michael I. Pupin, physicist, of Columbia University.

"The source of life energy is at present

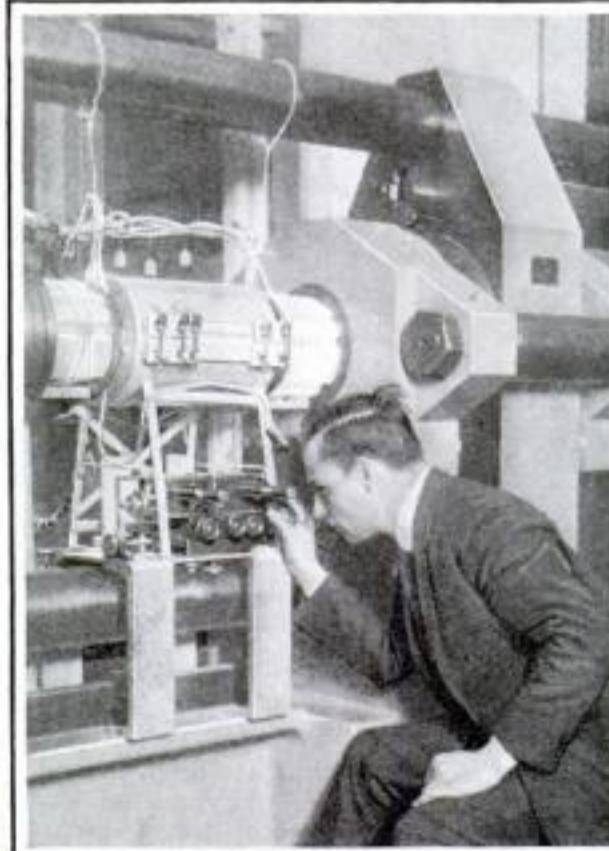
A discoverer of new secrets of our bodies—Dr. William Seifriz of the University of Pennsylvania, with the remarkably delicate microscopic manipulating instrument with which he has measured for the first time the elasticity of the human tissue



How hard and high does your auto bump? To find out, and to test shock absorbers and snubbers, Professor Fox of the University of Iowa has devised an artificial set of bumps, produced by a continuous treadmill with uneven surface. In the illustration, the professor is watching the results traced in jagged curves on a special seismographlike instrument

unknown," said Dr. Pupin, explaining his new theory. "We know that all chemical action is accompanied by ionization. We know that these rays—the so-called 'Millikan rays'—strongly cause ionization. My suggestion is that the ionizing power of these rays furnishes the energy of the living cells."

The cosmic rays are many times as penetrating as the most powerful X-rays and radium rays. Scientists believe they



Whether the steel framework of a burning building would collapse under the heat is determined by this device at the Bureau of Standards, Washington. Photo shows P. D. Sale reading the amount the girder yields, subject to high temperature and pressure



come from the sun and other stars, and that their energy is released when electrical particles, or electrons, combine to form atoms of matter in the stars under terrific pressure. The energy is sent flying through space with the tremendous speed of light.

If Professor Pupin's theory is correct, it is possible that tremendous transformations which took place in stars in the far-distant past, millions of years ago, may today be supplying the energy to every living cell in the animal and vegetable worlds.

Now Airplanes Excel Insects

SO RAPID has been the progress in airplane design that today man excels most of Nature's flying creatures in keeping himself aloft with wings. This conclusion is based on recent remarkable measurements made in France by M. P. Portier and M. de Rorthays. For comparison with the lifting capacity of airplane wings, they measured the wing areas of different insects, and determined the weights supported by these areas.

Modern airplanes support weights of from two to four pounds on each square foot of their wing surfaces; some even more. In contrast, the wings of a variety of carpenter bee, record holder in this respect among insects, were found to support a weight equivalent to only six tenths of a pound per square foot.

Many butterflies and other insects with large wings made even poorer showings. Some of them were able to support the equivalent of only a twentieth of a pound per square foot of wing surface.

Serum for Rheumatism

THE most important advance in medicine since insulin" is the way many physicians hail preliminary announcement of a serum treatment for acute rheumatic fever, commonly known as rheumatism. Credit for the isolation of the organism of this baffling disease and development of the antitoxin, if confirmed by further tests, will go to Dr. James C. Small, chief bacteriologist of the Philadelphia General Hospital, and his staff.

The First Beauty Parlor

Our ancestors cut their hair with clamshells—Some strange ancient inventions—How much your dog can understand—Facts about cyclones—Fascinating books

By THOMAS M. JOHNSON

"A Bird's-Eye View of Invention"

By A. Frederick Collins

Thomas Y. Crowell Company

DID you know that the first beauty parlor was equipped with a pair of clamshells? Or, if it was run by "Madame" Somebody, with a complete outfit of sharks' teeth? Perhaps a sharp edged flat stone stood in the corner.

That was all that was needed in those primitive times, but with such tools our ancestors gave themselves the first haircuts. Then they went down to the tailor shop to try on their new suits of bark fiber which the tailor had been beating with the rounded end of a club, on a smooth stone under water.

From that day to this, man has been inventing things, always doing something a bit better than before, or doing something nobody else had done before.

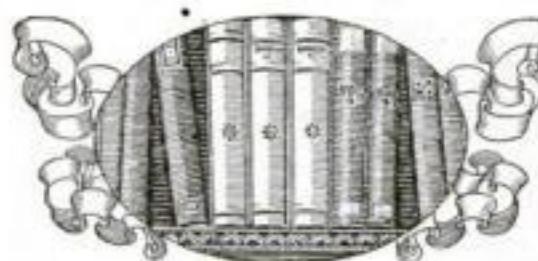
This book, "A Bird's-Eye View of Invention," abounds in statements of simple but amazing facts. For example, the following:

"That prehistoric man made measurements long before he had learned how to count, there is not the slightest doubt, and that he knew how to count long before he had invented figures, is a moral certainty."

Our three most indispensable tools, the hammer, the knife and the saw, were the first to be invented. After man had learned to saw with the jawbone of a snake or backbone of a fish, he set a fishbone in a stick and rotated it between his palms, and behold, he had a drill! Then he split a green stick at one end, and had a vise.

MUCH later, man found metals and how to use them. Long before Christ furnaces were built upon hilltops where the wind could fan them. Then came artificial wind, the first blower, a goatskin sewed up and fitted with valve and nozzle. Steel tools have been found in pyramids dating to 2500 years before Christ.

The original farmer loosened the soil with a stick, which was the



original hoe, and until the eighteenth century farm tools were very primitive. For a long time a plow was simply a crooked branch with a pointed fork. The first iron plow, patented in 1797, was a "flop" because the farmers thought it poisoned the soil! Until 1839 the harrow had not changed much from the Middle Ages. There was a great flood of useful farm inventions about this time—reapers, grain drills, binders and threshers. Considering the changes of the last fifteen years, it seems almost incredible that the gasoline tractor did not really "come in" until 1903.

"Power" was ushered into man's affairs by the treadwheel, invented long before the written history begins. It was made by fixing to a shaft paddles which a

man then stepped upon. A Saracen invented the windmill, and the Crusaders brought it to Europe in the twelfth century.

The first wheeled vehicle, a rough cart, was first drawn by man, its inventor, and later by a bullock. Railroad engines and cars did not come until 1769 and did not really work until 1804. The first American-built locomotive, the "Best Friend," burst upon public gaze in 1831 and later burst in small pieces, but was soon followed by others that did not.

RAILROADING has been one invention after another. In the first block system, for instance, the engineer passed a staff from one station agent to the next, much as relay racers do. Until the staff was in the station agent's hands, no train could pass into the same block, in the opposite direction.

Did you know that the first telegraph had twenty-six wires—one for each letter in the alphabet—and that the forerunner of the telephone was the old familiar "lovers' telephone" made by connecting with a taut string two cylinders, perhaps even tin cans? From such beginnings came "the most valuable single patent ever issued," given to Bell in 1876.

The author was himself an early experimenter in radio, and his chapters discussing wireless communication, including television, are among the most interesting in the book.

"Tropical Cyclones"

By Isaac M. Cline
The Macmillan Company

THIS book may help to prevent or at least to reduce the damage done by tropical cyclones, which the author has studied for thirty-seven years along the coast of the Gulf of Mexico. The result is that he has some ideas of his own that differ from those held by many.

He believes he has found how better to foretell the course of a cyclone, through the discovery that the air current in which the cyclone travels materially influ-

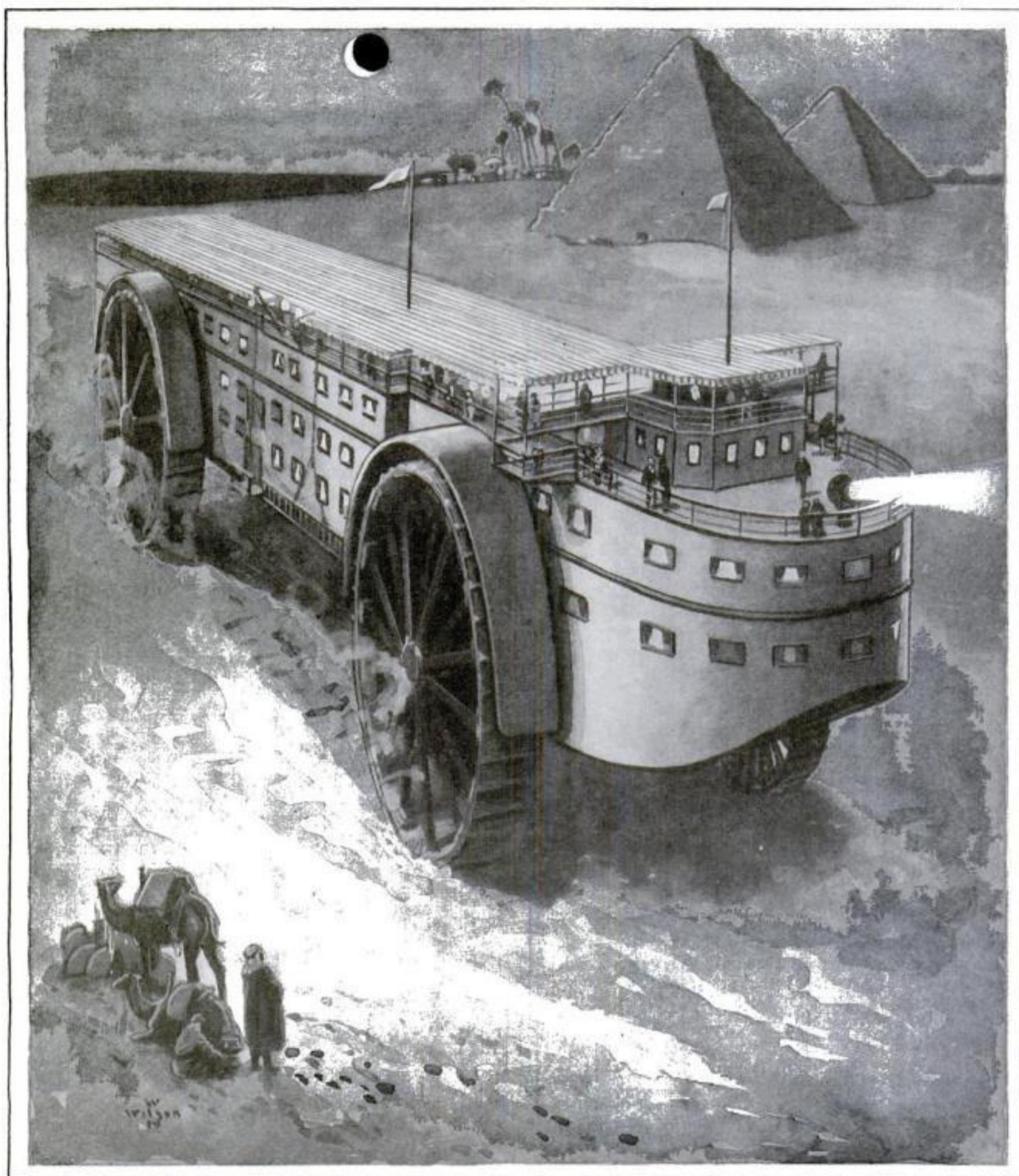
(Continued on page 143)



Trapping the Breeze Under Full Sail

SCUDGING before the wind, its huge spread of canvas bulging like an umbrella, this unusual little sailboat astonished spectators at a recent yacht race in Sydney Harbor, Australia. Although little larger than a catboat, it carries, beside a mainsail, a balloon jib and a flying spinnaker. The latter is set on the side opposite the mainsail by means of a long spinnaker boom. Sand is used as ballast

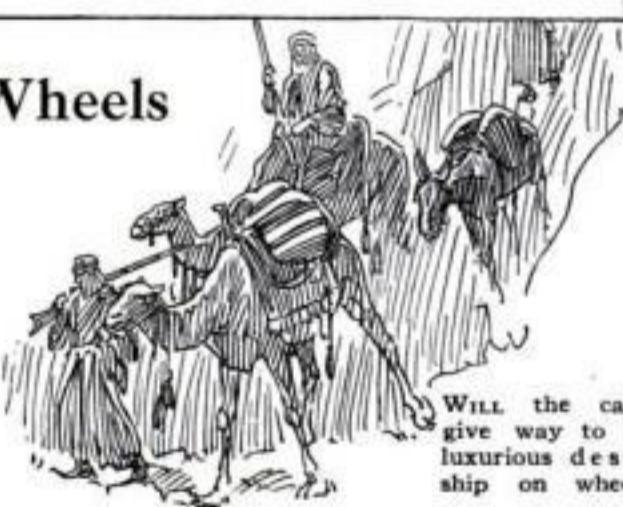
INGENIOUS INVENTIONS



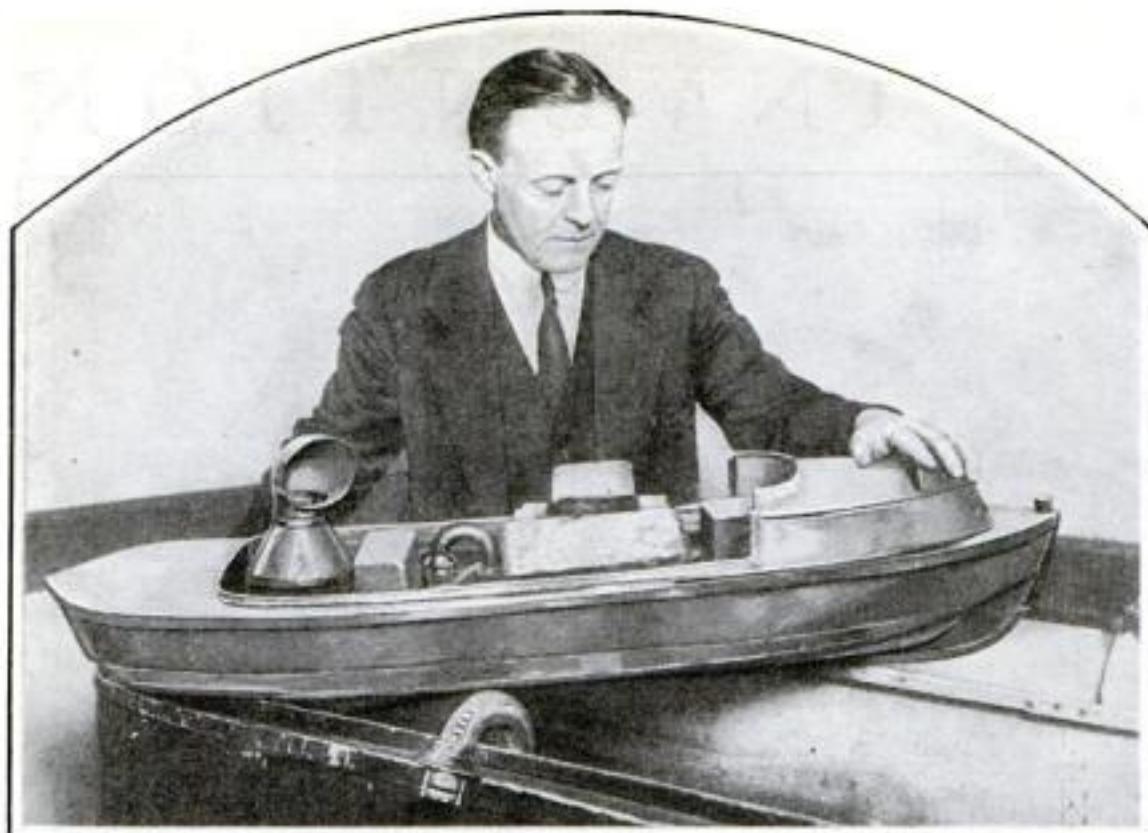
Huge Desert Ship to Speed over Sand on Wheels

AN OCEAN liner on land is the monster vehicle proposed by a German inventor, and pictured in our artist's conception above. J. C. Bischoff, of Kiel, the designer, sees desert travelers of the future embarking on a land ship that surrounds its 300-odd passengers with all the luxurious comfort of a modern sea liner. Within its windowed cabins the traveler would have no fear of hunger, thirst, nor the once-dreaded sandstorm. Gigantic gasoline motors in the hull

would turn the forty-foot wheels, which are rimmed with paddle-like blades to gain a firm foothold in the shifting sands. At the front of the 300-foot craft are the pilot house and steering apparatus, and from a near-by bridge the captain issues orders. At night a powerful searchlight would cast its beam over the sands through which the ship plows at twenty miles an hour in an airline to its destination.



WILL the camel give way to this luxurious desert ship on wheels?



A Boat That Couldn't Sink—It Bails Itself

IN THE belief that he has perfected a system that would make boats unsinkable, Fred N. Nelson, of Seattle, Wash., plans to demonstrate the model craft above before Navy officials. A unique self-bailer designed to eject water automatically from the hold, and a safety ventilator near the stern which admits air

but not water, are features of his plan. In the illustration, the inventor is about to test his device by placing the model, weighted down with bricks, in a tub to see if it will float.

Lifeboats equipped with this self-bailing system would be unsinkable under the worst storm conditions, says Nelson.

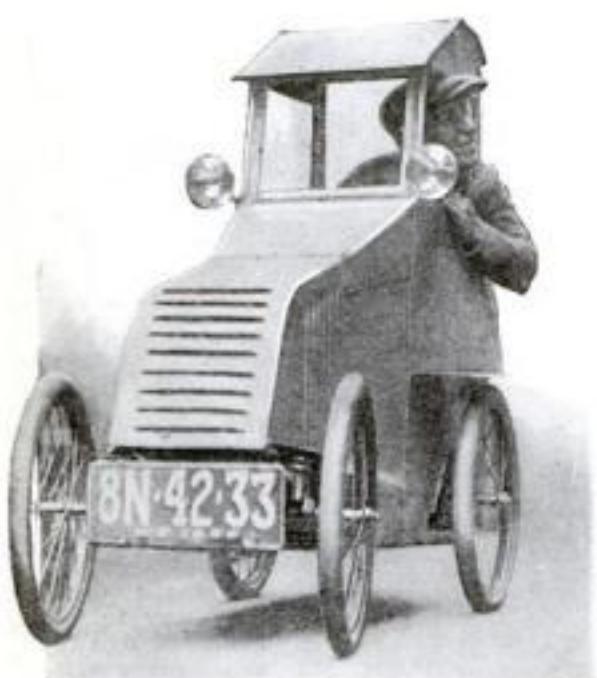
Navy Tests Oil Burner for Planes

AIRPLANES were run successfully on heavy oil instead of gasoline in recent tests, and special Diesel engines, burning this inexpensive fuel, may soon be installed in Navy planes, according to Dr. Joseph S. Ames of the National Advisory Committee for Aeronautics.

Two Feet Wide—a Real Auto!

PRETTY nearly the ultimate limit in small size for an automobile that can carry a man-sized passenger, the car below was built by Isidore Lubin, New York City mechanic. A little more than two feet wide, it threads its way easily through a maze of traffic that hopelessly ties up ordinary vehicles.

The little auto is surprisingly speedy, keeping pace with most large cars.

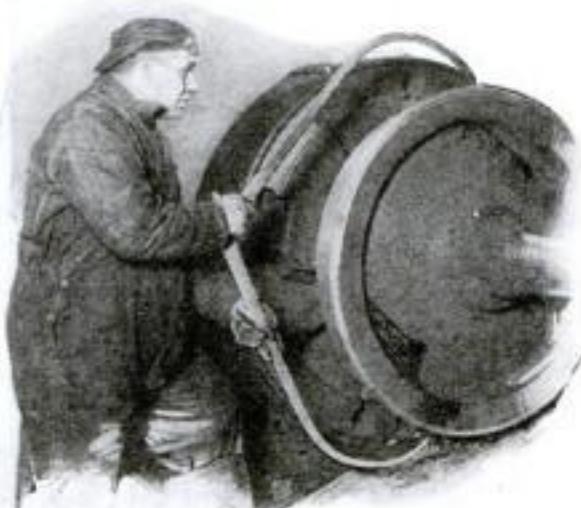


A mere slice of an auto, this—but on New York's crowded streets it has its advantages

This Automobile Horn "Talks"!

"**PARDON** me, but would you mind stepping out of my way?" is said to be the warning shouted by the newest auto horn, which addresses careless pedestrians through a phonograph loud-speaker. Admonished in such a manner, the astonished pedestrian could hardly fail to heed the automobilist's courteous injunction.

According to the new horn's inventor, Benjamin Freeble of Detroit, Mich., the same device could be used as a railroad crossing guard to announce, "Train coming on the east track!" or "All clear. You may proceed."



Some Calipers!

HAVE you ever wondered what they measure car wheels with? Here's how it's done in the Union and Pacific Railroad's shops—and you won't work those calipers with one hand, either. In this picture they're helping true up a pair of car wheels that are being turned in a special lathe.

Outside calipers are rated by the diameter of the largest circle they may be used to measure. They range in size from two inches up, but the larger sizes are rarely seen, especially those measuring more than three feet.



Laying rubber paving on a London street. At right, blocks used, showing rubber facing

London to Have Rubber Street

WHY not streets of rubber, as well as rubber automobile tires? So reasoned a Manchester, England, manufacturer, at whose cost New Bridge Street, London, is being paved with rubber blocks. The heavy traffic on this street, he expects, will give a conclusive test of his claims that rubber paving will reduce dust, noise and the danger of skidding, at the same time proving as durable as conventional paving materials.

As used in this unusual construction job, the new blocks, one of which is illustrated, are made of terra cotta with a rubber facing. They are laid and cemented together like ordinary blocks, as shown in the photograph above.

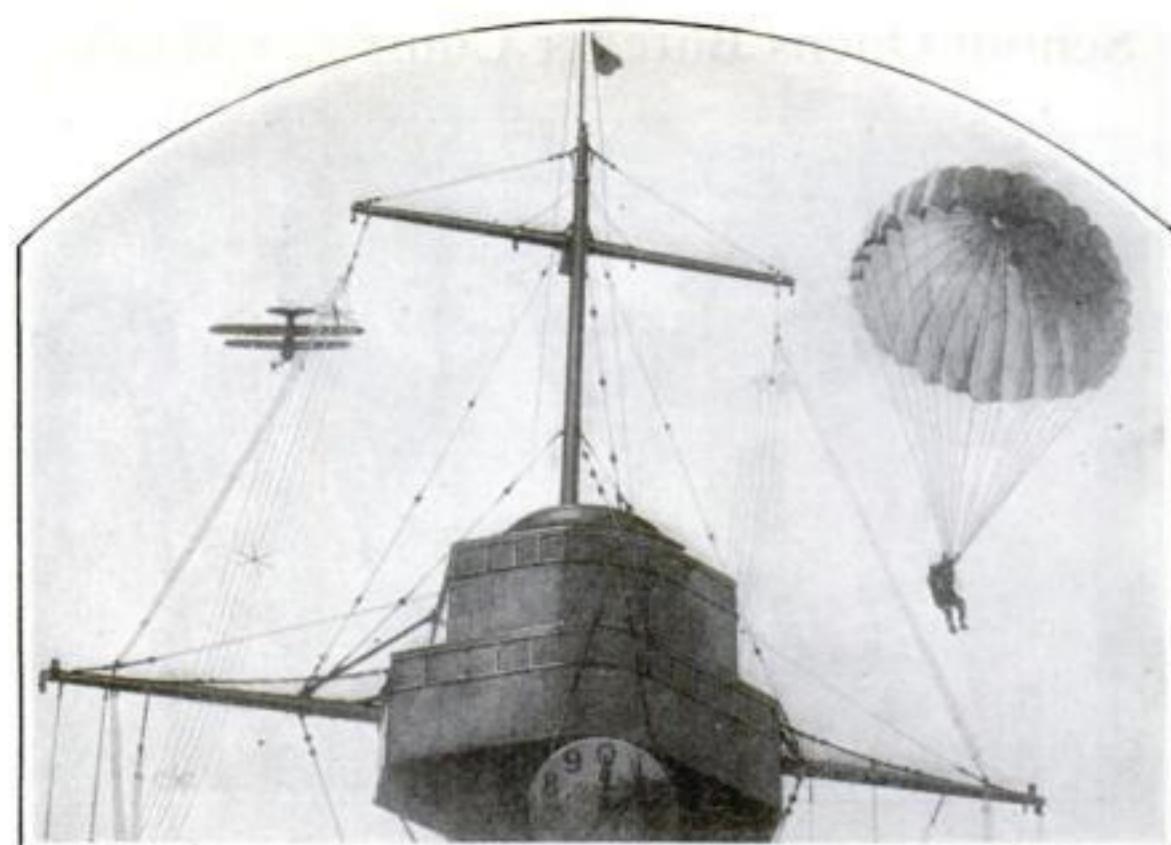


Electric Device Subs for Heart

WHEN does life cease, and physical death occur? Apparently not even after the heart has stopped, according to reports of a remarkable instrument invented in Russia which mechanically takes over the function of the heart. The electric "heart" was tried out on a dog officially pronounced dead. In a few moments, it is said, the machine started up the animal's circulation again, its eyes opened, and for several hours it gave signs of life and reacted to tests for the perception of light and pain.

Radio "Eyes" for Ships in Fog

WHEN heavy fog blankets the sea and an approaching vessel might be seen too late to avert a crash, radio beams may in future automatically warn of the ship's approach, if a remarkable new device comes into general use. Dr. F. A. Kolster, inventor of the well-known radio compass, has perfected the new electric beacon, which, he says, automatically broadcasts a warning signal over a ten-mile radius to other ships in the path of the oncoming vessel. Installed in the pilot house and independent of the ship's wireless, it is turned on in foggy weather. Other craft locate the signals and take steps to avoid a collision through the use of the radio compass, which tells the direction the signals are coming from.



Parachute Jumper Misses Death by Inches

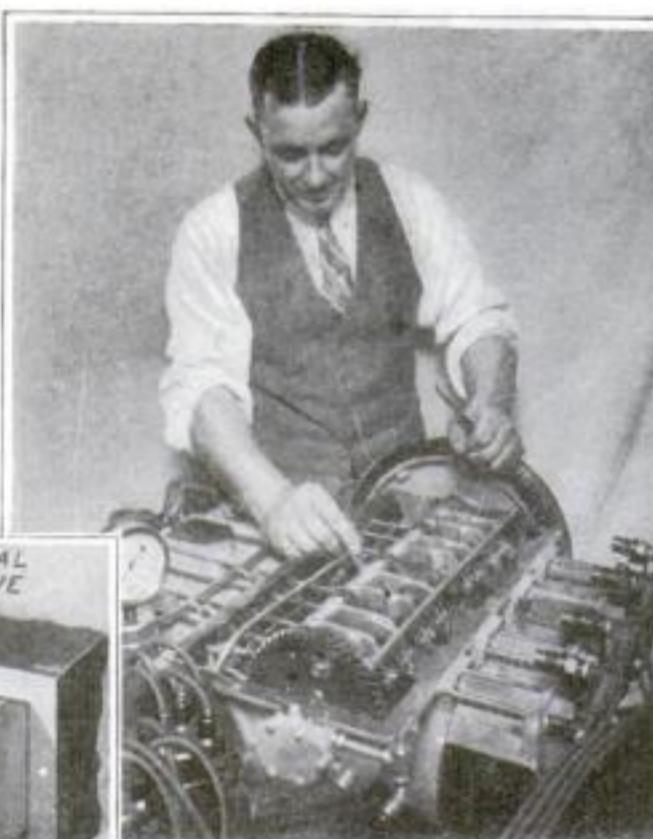
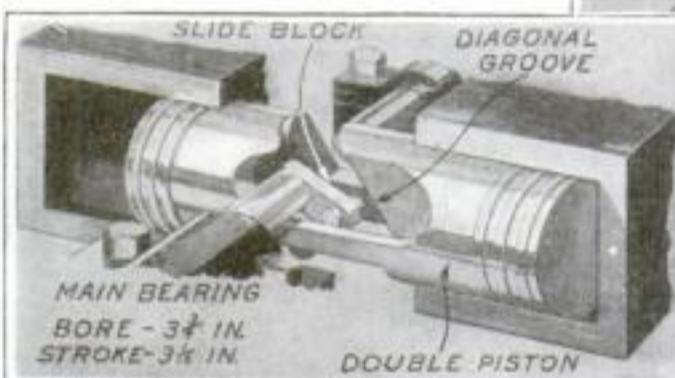
THIS parachute jumper had a few tense moments when he catapulted from a speeding scout plane directly over the dreadnaught *California*, during recent maneuvers of the Pacific Fleet off San Pedro, California. A lucky wind bore

him safely past, but at the moment that this remarkable picture was taken he barely missed the jagged spars that would have slashed his parachute and sent him hurtling to the deck far below. Fortunately, he landed safely on the water.

Austrian Invents Rotary Motor

OF RADICAL new design, the gasoline motor above, invented by an Austrian engineer, is said to achieve high efficiency by using a rotary instead of a reciprocating motion. Like a turbine, its impulses whirl a high-speed crank shaft. No power is lost in reversing the movement of a heavy piston, as in the conventional type of motor.

At right, Bosmans demonstrating his revolutionary engine (in the picture, spark plugs have been removed). Below, diagram showing the piston action



Amazing Engine Has Fewer Parts

OF EXTRAORDINARY design, a new auto motor having no connecting rods, wrist pins, or crank case, and said to allow twenty percent more mileage to a gallon of gas, has just been invented by John A. Bosmans, of Brooklyn, N. Y. Owing to its simplified construction, Bosmans says, its efficiency is doubled; and he can take the motor apart, remove the crank shaft and put it all together again in thirty minutes. The same simplicity, he declares, will decrease its cost of manufacture to a fraction of the present cost of an equally powerful engine.

Eight cylinders are set in horizontal blocks on opposite sides of the motor.

There are four double-headed pistons, each working in two cylinders! As one cylinder fires, the gas in the opposite one is compressed, and a moment later the cycle is reversed. Power reaches the crank shaft through a four-sided bearing that slides in a diagonal groove within the piston, and each revolving bend of the crank shaft is entirely contained inside the hollow piston shell.

More than twice as long as in ordinary motors, the unusual piston cannot wobble as much as a short one within the cylinder walls; hence it will not wear down the piston chambers and make regrinding necessary. Absence of vibration and unusual fuel economy are other results claimed for this remarkable construction.

New Auto Light Reduces Glare

DAZZLING glare is said to be reduced to a minimum, in a new type of automobile headlight invented in Germany having two separate light bulbs, one used for a strong beam straight ahead and the other arranged to throw the light downward. The change from one type of beam to the other is made by a foot switch.

Giant Rope Weighs Five Tons

DELIVERED a few weeks ago to a Boston, Mass., firm of shippers, this record-breaking ship's hawser, below, had to be transported in a special freight car of a size to accommodate its huge bulk. Nearly a quarter of a mile long, the mighty cable weighs nearly five tons, and measures a full fifteen inches in circumference.

With such ropes, giant craft may safely ride out the fiercest gale. Ordinary ship's hawsers average from five to ten inches, and from 900 to 3600 pounds.



The world's biggest ship's hawser looks its size, contrasted with a coil of ordinary sized rope!

School Opens Butcher Course to Women



Learning how to swing the butcher's knife and handle his saw and chopper

MODERN women are abandoning the rolling-pin for the cleaver, judging from this picture from the Smithfield School, Saffron Hill, London, England, where the recent admittance of women to the butchering course has met with amazing response. The young women are serious workers and soon become adept at swinging the formidable tools hitherto regarded as exclusively masculine property. The course includes thorough instruction in the anatomy of

the animals we eat, in the questions of preservation and refrigeration, and in modern butcher shop sanitation. The photograph shows women students chopping, sawing and cutting meat.

KNOW YOUR CAR

MODERN automobile transmissions and rear axle assemblies have been so perfected that trouble with these parts is becoming quite rare on any make of car until it has been in use for thousands of miles of driving. In fact, these parts of the car will go on giving service even when they are badly neglected. Neglect most often takes the form of lack of proper cleaning-out at regular intervals of 5,000 miles, and failure to lubricate with a fresh supply of transmission oil.

Aside from proper lubrication, the chief cause of excessive wear on the transmission or rear end of a car is harsh gear shifting and attempting to accelerate too rapidly. Just because your car is capable of getting away to a flying start is no excuse for making it perform that way all the time.

For long and satisfactory service from the transmission and rear axle assembly of your car, follow these rules:

1. Clean out old lubricant at least once every five thousand miles.
2. Always use the grade and make of lubricant recommended by the car manufacturer.
3. Let the clutch in gently and pick up slowly.



Tobacco Pouch "Pours" Easily

HERE'S an all-metal tobacco "pouch" that will not grind your pet mixture to ill-tasting dust, nor spill tobacco over the user and floor in filling a pipe, according to the inventor. A small section of the hinged lid opens to release an easily controlled flow of the brown grains, and the whole lid swings back when the case needs replenishing. It fits in a vest pocket, and holds a day's supply.

New Autogiro Model

RADICAL changes have been made in a new model of the "autogiro," strange helicopter-airplane hybrid, by its Spanish inventor, Juan de la Cierva, whose first successful machine of this type was described some months ago in POPULAR SCIENCE MONTHLY. In the original design, four huge horizontal windmill-like blades pivoted on a rigid shaft above the plane helped to support it in flight. The new model enables this shaft with its blades to be tilted during flight to meet varying air currents. The shape of the "windmill" blades is also changed. Four wheels replace the original two, with brakes on the front pair that bring the craft to a stop in a short space.



Silent Rifle Penetrates Steel

SHOWN above is the remarkable "silent rifle" recently reported from Germany, with its inventor, Hermann Plieth, a Berlin locksmith. The rifle uses, instead of powder, compressed air. Twenty-five bullets are contained in its magazine, which can be fired automatically, without reloading. How he compresses the air to propel bullets at rifle speed from the muzzle, Plieth refuses to disclose. But in tests in the presence of Reichswehr officers, the bullets are said to have penetrated three millimeters (nearly one eighth of an inch) of steel at a distance of more than a mile!



Checkerboard of 14,000 Pieces!

FOURTEEN thousand separate pieces of wood are contained in this amazing checkerboard, made by Henry J. Bellarts, Jr., a young mechanic of Portland, Ore. Mahogany, maple, oak, cedar, birch, black walnut, hickory, gumwood and ash were all used in working out the intricate design. The board is twenty-six inches square, and the wood inlay is made up of three-sixteenth-inch blocks. It took Bellarts eighteen months to complete.

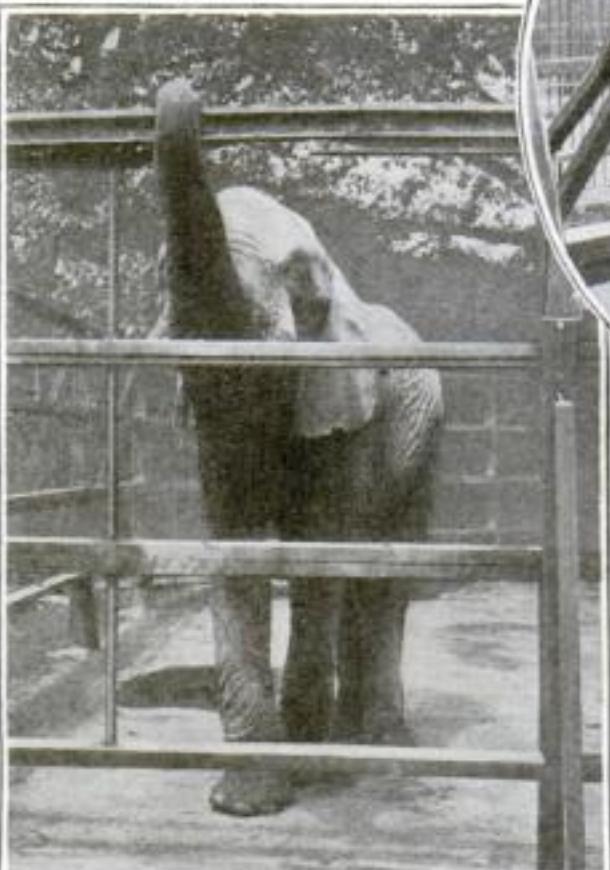
Miniature Golf Course for Business Men



Invents Pump for Oil Wells

AFTER several years of experimenting, Adolph Chanovsky, a young oil operator of Texas, invented a novel pump which, he says, will take oil, sand and water from the deepest part of any oil well.

The pump, which also can be used as a sand sucker, consists of two pieces of tubing, as shown in the illustration above, one inserted into the other, a small ring, and a piece of padding.



Handy Blotter Fits on Pen

FASTENED to the clip of your fountain pen, this diminutive blotter illustrated at the right is always at hand when you need it. The flat part of the clip carries three small pieces of blotting paper, just big enough to use on a signature or short memorandum. The rectangular shape of this part keeps the pen from rolling about on the desk and protects it from breakage. An Illinois business man invented this ingenious device to aid him in the rapid signing and blotting of his busy correspondence.



Enjoying a round of golf on New York's new indoor course between business appointments

GOLF between appointments is now possible for New York business men, on a miniature indoor eighteen-hole course located in the heart of the financial district. Each "green" requires a

different style of approach, and ingenious hazards call forth every club in the golfer's bag.

The player "tees up" his ball on one of the raised rectangles and tries to sink it in the corresponding hole. If the ball rolls over the side to the floor, which is the "rough," it is replaced at the cost of one stroke. A few holes, such as the one in the center of the illustration, are straight and level, but most have curved approaches and tricky inclines. At the left is a hole which must be approached by hoisting the ball over a fence.



What An Angry Elephant Did

THIS African elephant at the New York Zoological Park decided the other day that he wanted his freedom. The steel beams of his cage barred the way, but he merely put his mighty trunk into action and massive bars were twisted, thick bolts snapped like glass, and ponderous rails were hurled about like straws.

The keeper, above, is examining the wreck. Now they've built the elephant a new cage that is twice as strong.



How Much Do You Know of the World You Live In?

IF you are as observant as you should be, you ought to be able to answer at least half of the following questions, selected from hundreds sent in by readers. Turn to page 137 for the correct answers.

1. What is the greatest astronomical observatory in the world?
2. Where are diamonds found in the United States?
3. Why is the magnetic compass useless in the Arctic regions?
4. Where did the Aztecs get their stores of gold?
5. What land did Columbus first discover?
6. Where is platinum found in America?
7. What city has sidewalks built in two stories?
8. What is the hottest place in the world?
9. Which are the oldest mines in the world?
10. What are the monsoon winds?
11. Where is the most active mixture of races going on?
12. On what island is Honolulu?



Hoisted nightly by a derrick over the Parisian boulevards, this dazzlingly illuminated globe stands out conspicuously against the sky, the latest advertising idea of a round-the-world steamship company. Around the face of this novel globe travels a ship, also electrically lighted



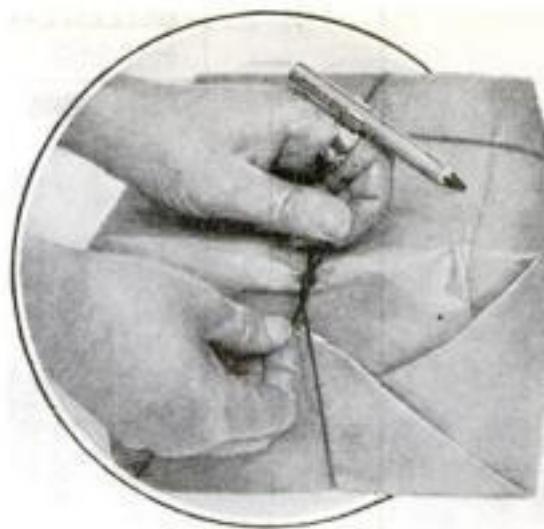
Through the water off Los Angeles, Calif., a few weeks ago, raced this amazing little motor boat, the *Bullet II*, to hang up an unofficial world's record for outboard motors of 23.11 miles an hour. Owners of high-priced craft received a profound shock, for the small speedy craft cost its designer and constructor, Dr. R. F. Fiske, exactly twelve dollars to put together, exclusive of the motor



Hit the front pin true and squarely and all the rest will topple—but it's harder than it looks, explains George Allen, of Georgia, to Bobby Jones, golf champion (left, standing). Skill at putting is the object of this golf-bowling game, which Allen invented



Smaller than the can that oils it, this microscopic gasoline engine, built by William A. Bruno, of New York City, chugs like its big brothers as it develops its maximum capacity of one eighth of a horsepower. Gasoline and oil tanks attached to the wall are in proportion, as is the tiny spark plug



You won't lose your pencil when you need it most, if it's tucked in this handy pencil holder that slips over your index finger. The ring is adjustable for any thickness of pencil, and leaves both hands free to tie up bundles or for other tasks

Here and There with the Inventors



This ingenious little cigar lighter, resting on the side of the ash tray, lights of its own accord when you pick it up. Replace it, and a concealed switch within automatically turns off the electric current.

Amazing Speed Boat Built for \$12, Midget Gasoline Motor, Auto Crime Laboratory, Cigar Lighter and Other New Devices



Serving a double purpose, this globe lighting fixture both illuminates the geography classroom of an Eastern school and enables the instructor to give added point to remarks on the locations of continents and countries.



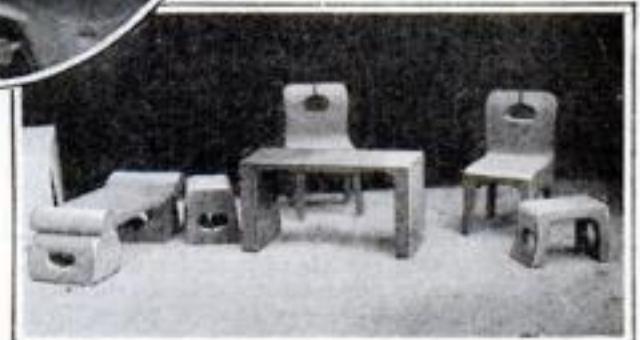
Hot on the trail of a criminal, this Berlin police auto rushes detectives to the scene of the crime to record clues while they are fresh. A camera, a medical outfit and a search-light are all parts of its equipment, while folding chairs and a collapsible table make it an independent laboratory.



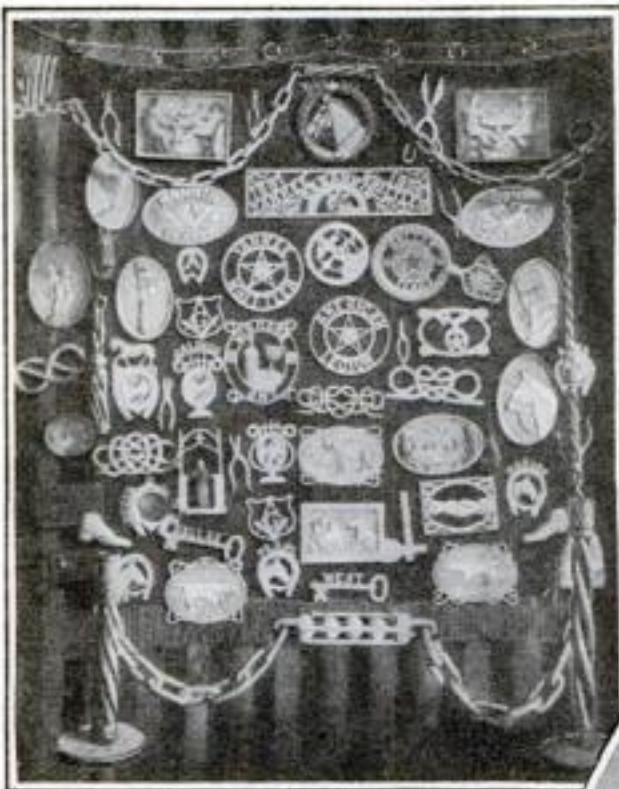
When you breathe, just what happens inside your lungs? Scientists have devised this imposing array of equipment shown recently in Washington, D. C., to discover the chemistry of breathing. The apparatus at the left measures for analysis the air that the subject inhales, while at the right another row of bottles collects the various products of his respiration.



Out of a single block of wood comes this complete set of toy furniture—and by means of two pegs to hold the pieces together the set can be "nested" again to form the original block. With the aid of a scroll saw, H. E. Seibert (left) of Los Angeles, performs this magical transformation. The set is shown in the photo below.



He Whittles Chains from Toothpicks



Some of D. D. Rankin's whittlings and, at right, the master whittler himself, making the twenty pairs of pliers, which fold back again into one stick of wood

TWENTY miniature pairs of pliers which unfold from a strip of wood a quarter of an inch wide and sixteen inches long, is only one of the whittling feats claimed by David D. Rankin, of Detroit, Mich. To pass the time on a rainy day, he will carve a five-link chain from a toothpick, and one with ten links, or, perhaps, three pairs of pliers, from a single ordinary matchstick.

Some of the intricate pieces which Rankin has carved from wood are shown at the left, including ornamental designs and emblems, in bas-relief and openwork; chains, the longest of which measures twenty-three feet, and tools.



Ship Models of Bone

TO THE ever-increasing list of specialized professions must be added that of T. Beaufort of London, England, whose unusual occupation is the restoring of bone models of historic sailing vessels. Some of the models, the details of which are carefully made to scale, were the work of French prisoners at the time of the Napoleonic wars. Bones from their own tables and the cooks' kitchens were the only materials they had to use, yet with these they shaped and polished gracefully curved planks for the ships' sides, worked out every detail, and finished their work off with delicate carving. At present the miniature replicas are worth from \$1250 to \$5,000.

Mr. Beaufort is shown below checking up the measurements of one of the damaged ships he is repairing.



Restoring ship models of bone his unusual occupation: T. Beaufort, above, shown checking the dimensions of an old warship model, which is complete in every detail



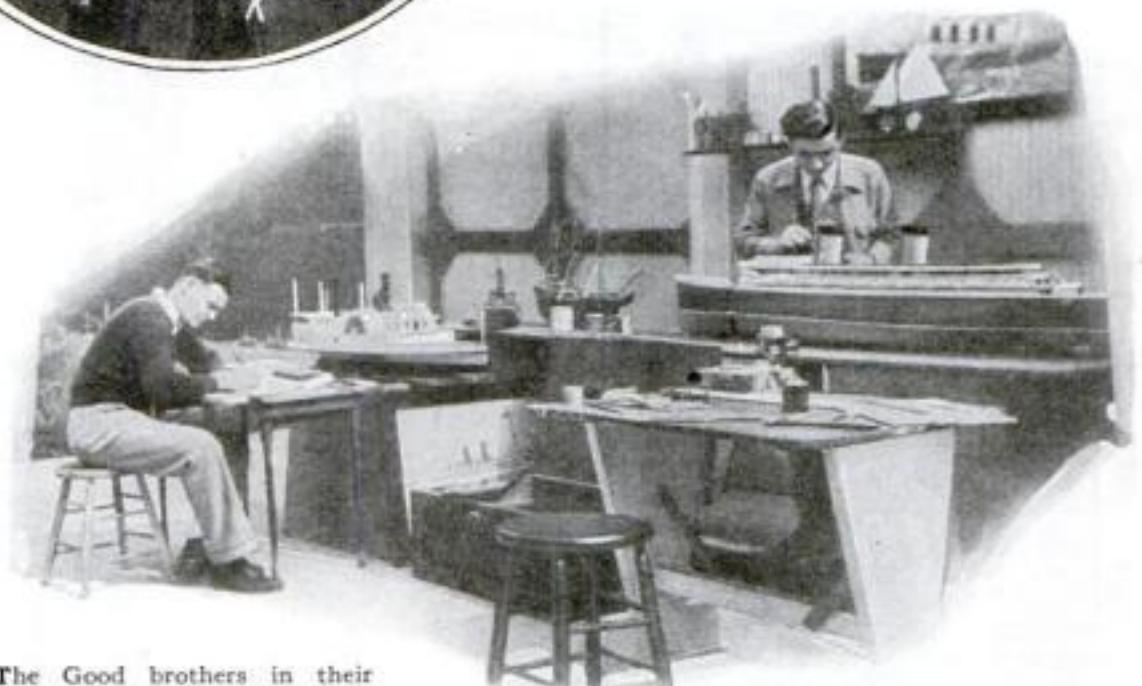
Half-Pinters—Quart Appetites!

SCARCELY larger than the bottle of milk they are feeding on, these half-pint deer, newest arrivals at the San Diego, Calif., zoo, are seen taking their eleventh breakfast in one morning. When only five minutes old they were jumping about with the lusty vigor of young bucks. They weigh only nineteen pounds each just now, but give them time!

World's Largest Searchlight

A SINGLE beam of light from the world's largest searchlight near Paris will soon guide night-traveling airplanes southward from the coast of France at the point where they arrive from England until the aerial lighthouse at Dijon picks them up and directs them with another beam on to Marseilles.

This light, powerful enough to pen-



The Good brothers in their workshop, where they construct models of famous steamships

They Made a Hobby Pay

TWO brothers of Pasadena, Calif., Wallace and Roscoe Good, are shown above at work on a model of the S. S. *Malolo*, one of the largest steamships ever built in this country, which is to be placed on the San Francisco-Honolulu run this spring. The building of steamship models, first taken up as a pastime, has developed into a profitable business for the brothers.

The model above, scaled down to one eighth inch to a foot, is seventy-three inches long. Every detail of the construction is reproduced in exact proportion, the model being constructed from the blueprints used by the builders of the *Malolo*. The hull and superstructure are pine, the davits and anchors white metal, and the propellers and fittings brass.

trate heavy curtains, is located at the top of Mt. Valerien, the highest point in the immediate vicinity of Paris. Its twin reflectors measure each about six feet in diameter and its arcs are lighted by a hundred-horsepower plant.

While the expense of running such an outfit is naturally great and the light will be used only when needed, it is expected to handle the regular commercial airplane service from London to Marseilles.

New Loud Phonograph Invented

A REMARKABLE new phonograph said to have the tone volume of twenty orchestral instruments is a new invention reported from Germany. Tone volume is said to be augmented by the influx into the soundbox of a mixture of atomized air and oil generated by a hand pump and projected to the resonator.



Now—the Airplane Trunk!

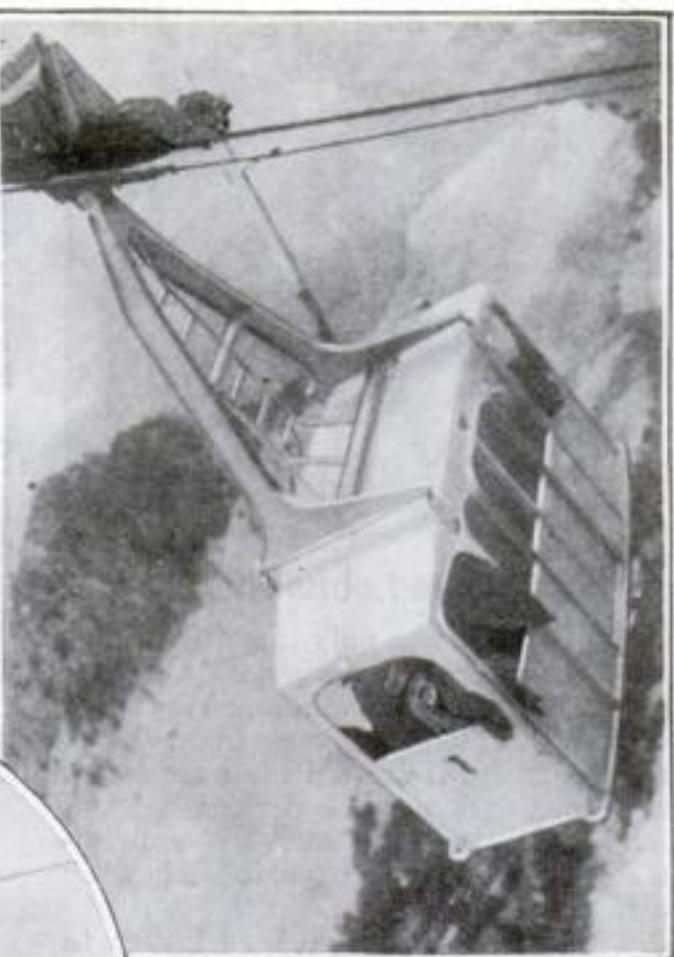
YOU can carry an entire wardrobe in this ingenious new piece of luggage, which, though the size of an ordinary suitcase, has the capacity and clothes protection of a wardrobe trunk. Designed for the limited accommodations of airplane travel, it is equally convenient as a space-saver on a train, where it slides out of the way under a Pullman seat. It would also prove useful on an automobile or steamer trip.

Within its modest dimensions, according to the maker, is space for four suits, two extra pairs of trousers, and other articles of a man's attire; or, in the model for women, twelve dresses can be tucked away, with plenty of room to spare for incidentals. When the case is opened, hangers that keep the clothes from wrinkling may be drawn forth for ready access. The model illustrated is only nine inches deep.

Last Word in Aerial Railway Luxury

SUSPENDED high above the Bavarian Alps, the workman below seems as comfortable and unperturbed as the occupant of the luxurious cabin at the right, which is the standard rolling equipment on the new Alpine aerial railway up the Zugspitze, recently completed. The occupant of the cabin is no less a personage than the president of Austria, Dr. Michael Hainisch, who took the first ride over the cables. The workman is inspecting the cable to make sure everything is secure for the inaugural trip.

The new railway is nearly 10,000 feet high, and runs to the summit of the highest mountain in the Bavarian Alps, the Zugspitze.



Above, type of car used to carry sight-seers to the top of the Zugspitze, in the Bavarian Alps. Left: Workman making a tour of inspection of the newly erected cable before the initial trip

His Galleon Wins Prize

THIS model of a Spanish galleon, illustrated below, made by a convalescent patient in a New York City hospital after the design first published in the May, 1926, issue of POPULAR SCIENCE MONTHLY, recently brought a substantial sum at a benefit sale for shut-ins held at the Women's City Club of New York. The illustration shows Bird S. Coler, public welfare commissioner of New York City, buying the model from Mrs. H. Edward Dreier, president of the club. The constructor of the model has skillfully and faithfully carried out the majestic lines of this type of Spanish fighting ship, which was also used for the transportation of gold.



This magnificent model of a Spanish galleon was built by a patient in a New York hospital



A Speed Boat Disaster Made to Order

SNAPPED just as the racing speed boat blew up with a terrific detonation and a shower of splintered wood and flaming gasoline, the remarkable photograph above shows what horrified spectators witnessed the other day at a race at Newport Bay, near Los Angeles, Calif. No one was injured, however, in the spectacular explosion, which was staged for a movie thriller. The pilot of the demolished craft leaped to safety a moment before the explosion, and was

picked up by another boat. Clever photographic work will eliminate the leap overboard from the completed photoplay, making it appear as if the "villain" perished in the blast.

SPIRITS OF TURPENTINE is made from the sap of trees—in America from the long leaf pine—the sap being drawn from the tree much as maple sap is. Distillation causes a thin fluid, which is turpentine, to separate from the mass.



Freak Tree Loops the Loop

WHEN it was only a few feet high, this tree apparently decided that it didn't like the world's looks, so it turned back in the direction it came from. Then, after a while, it started life over again, and the result was the curious freak of nature in the illustration. Notwithstanding its unusual shape, it is a healthy and thriving specimen.

Trees, of course, have been known to overcome amazing obstructions in seeking a path for growth, even dislocating floorings and walls in buildings underneath which they had taken root; but the forest trumper who came upon this one could discern no apparent obstacle to its normal development.



Meet the Acrobatic Musicians!

PLAYING twenty-odd instruments at the same time is a simple matter if you use your mouth, elbows, fingers, knees and feet simultaneously, say these two brothers, Cicero and Abner Weaver, founders and sole members of the Arkansas Jazz Band. Cicero, at the left, is demonstrating a quaint instrument of his own design. Combined with it are a few bells, an automobile horn, a cymbal and a pistol (attached to the end).

A tambourine, time cymbals and another noise-maker of original design and fearful results are strapped to Cicero's legs. Abner's curious banjo-mandolin supports a horn, too, at the right height for his mouth. The odd-looking rake is really a "flute," and the musical saws and zither complete the outfit.

The brothers have been touring the country with their unique instruments.

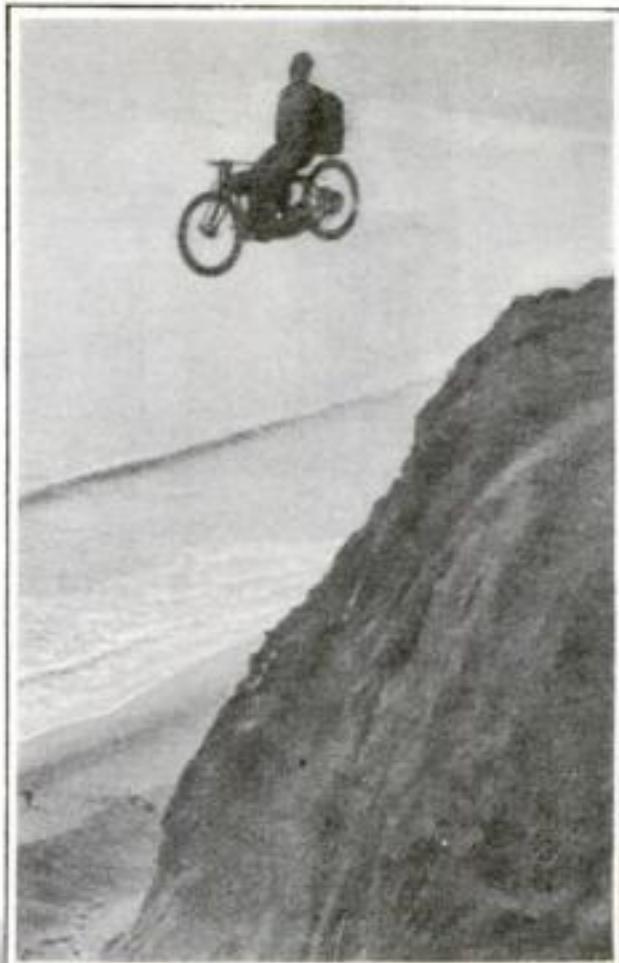
Rides Off Cliff, Parachute Fails to Open!

WHEN Fred Osborne, daring air pilot of Santa Monica, California, drove a motorcycle at high speed over the edge of the Huntington cliff north of that city recently, he carried on his back a parachute that he expected would lift him from the saddle and float him down gently to earth. The parachute failed to open. Man and motorcycle went hurtling into space and plunged toward the ground far below, where the spectators watched horrified.

By a miracle Osborne was not killed outright, his dizzy fall being broken by telephone wires. He was carried from the beach in a critical condition. The motorcycle, a twisted mass of wreckage, burst into flames. Notice the half-opened parachute at the left of the photo below.



Osborne at the moment he expected his parachute to open. Left, after the crash



Old and New in Strong Boxes

ACENTURY ago, people kept their valuables in strong boxes like the one in the picture below, with iron padlocks and creaking hinges. Just behind it is the last word in theft-proof deposit "boxes," the new vault of the Bank of America in New York City. Note the complicated locking mechanism, with its train of gears that operate formidable bolts all around the rim of the circular door; and the massive hinges, smoothly supporting the tons of hardened steel that hang from them.

The old strong box in the picture is said to have been captured by the British troops during the War of 1812.

A RED diamond weighing eighteen carats has been reported found in the Lichtenburg diamond district, South Africa. Red diamonds are very rare and command high prices.

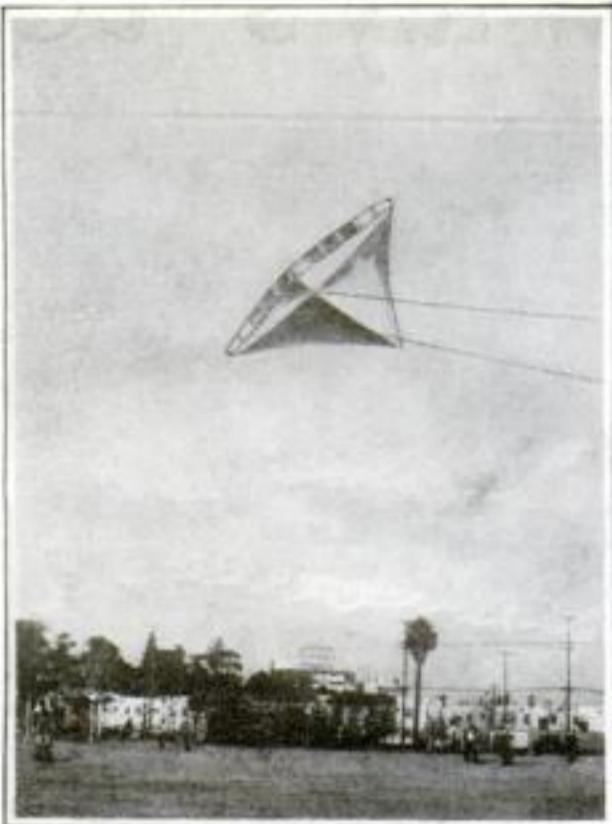
Pale Hands Warm, Red Cold?

WHITE hands, contrary to general belief, may be warm, and red hands cold, according to a report to the recent congress of the Society of German Natural Philosophers and Physicians at Dusseldorf. The warmth of the hands depends solely upon the amount of blood supplied to them, it was pointed out. The color, however, is determined by the position of the capillaries.



Edward C. Delafield, president of the Bank of America, New York City, contrasting the "strong box" of a century ago with the mighty geared doors of a modern safe deposit vault

Remarkable Kite Built to Carry a Passenger



The Argabrite kite in a test flight at Los Angeles. At the right the kite is shown before the flight, with Mrs. Argabrite in the cockpit, her husband holding one of the ropes and friends the other.



TINY spiders, the highest-up animals on earth, have been found living 4,000 feet above any vegetation on the slopes of the Himalaya mountains in Asia. Since they are entirely surrounded by snow, ice and rock, the minute creatures must eat each other for food.

Who Says Bike's Out-of-Date?

YOUNG America demonstrates, below, that, far from being old-fashioned, the bicycle is still a highly popular method of locomotion. This small army of two-wheeled vehicles is not the start of an international bike race—it's just an everyday scene after school at a junior high school in Los Angeles, Calif., where 300 pupils "bike" daily to and from their homes and school. Parking space has been provided by the school authorities.



No special bus service is needed to take these Los Angeles boys to and from school!

SIX men have all they can do to hold this giant man-carrying kite by long ropes while it soars aloft. It has carried its inventor, George A. Argabrite, of Los Angeles, Calif., far above the earth more than two hundred times without mishap. As seen on the ground, in the picture below, its lines suggest an airplane. In flight, the lower half is visible as a wing and tail combined, completely obscuring the figure of the passenger.

Two separate ropes are used to steady the man-carrier in flight, one attached to the bottom framework at the front and the other near the tail. Complete landing gear, including four small rubber-tired wheels, insures a smooth descent. A dummy was the passenger in the first trial flight, which demonstrated that the machine would carry Argabrite's 186 pounds aloft in complete safety. The kite can also be anchored in the air, and used for observation purposes.



Tropic Fish Has Nest Like Bird

AN ODDITY of nature, this strange fish, of the genus *Epinephelus*, found in the tropic seas of India, weaves a nest of seaweed in an underwater tree. Like a bird, it lays and hatches its eggs within the nest. It is easily frightened and changes color when a funny enemy approaches too close.

Microphone for Witnesses

JURORS don't have to strain their ears to catch every word of a witness's testimony, in a Baltimore, Md., court room, where witness's words, spoken in a low voice into a microphone, are amplified by a loudspeaker for the judge and jury. Supreme Court Judge Joseph N. Ulman has installed the system in his court room.



Pressing one button records one stroke; pressing the other one sends hand recording the number of strokes per hole back to zero

Golf Watch Ticks Off Strokes

WITH this new counter, there can be no argument as to whether the golfer took six or seven strokes to make a hole. After each shot, he presses a button to register it on the counter; when he has "holed out," another button returns the pointer to zero ready to record the strokes of the next hole. Resembling a watch, and strapped to the wrist, the golf meter records this score on its "minute hand," and an "hour hand" totals the strokes for the game.

Sixteen Ways to



Not only does this ingenious machine slice fruits or vegetables to any thickness, it also "shoestrings" them or cuts them to any shape desired, for use in salads and fancy dishes



Is there water in the milk? The housewife can tell in a jiffy, with the testing instrument shown above. It reveals whether milk is skimmed, unskimmed or watered, according to the last number visible on its scale as it floats in the liquid



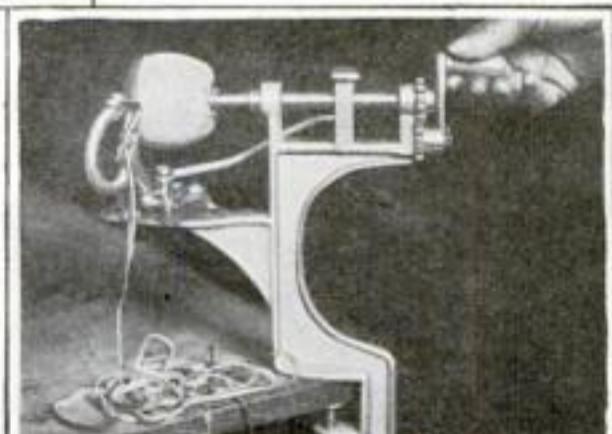
Steam-poached eggs are easily made in this new poacher, with its tray of individual removable cups, its lower pan for boiling water, and its deep cover for steaming



Knives can be sharpened in a jiffy with this handy grinder. Place the knife between the wheel of abrasive material and one of the adjoining metal cones, draw the knife back and forth, and the job is done



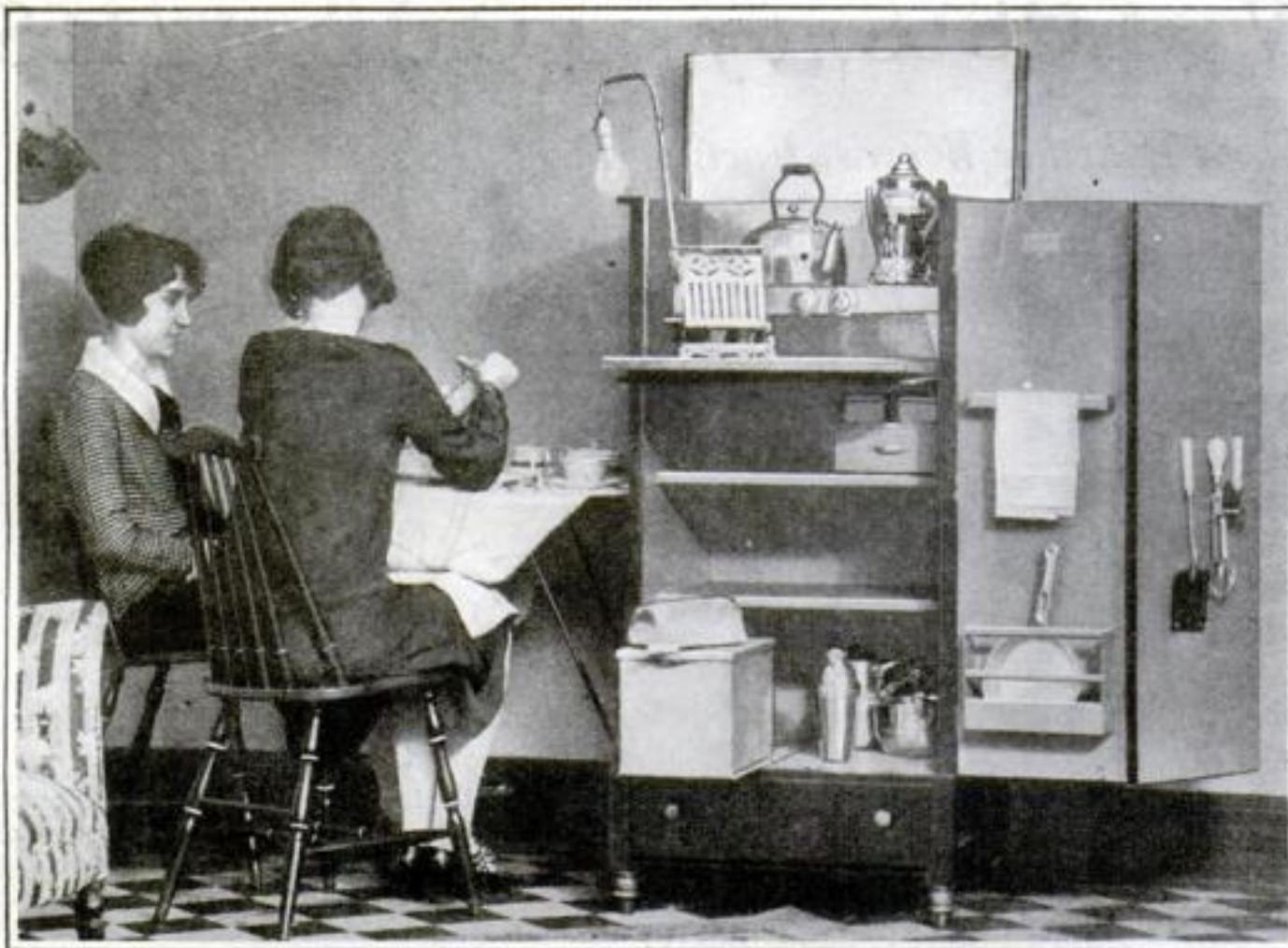
Used for making beef tea and other meat extracts, this little cooker is placed in water in an ordinary saucepan. With meat or vegetables and a small quantity of water within, the device is sealed and heated in boiling water until the full flavor of the meat has been extracted



Peeling potatoes or apples loses its drudgery when all you do is turn a crank, as with this ingenious peeler. A sharp knife removes the peel in one piece as the shaft holding the apple moves lengthwise on a screw

Closet space, always at a premium, is made the most of by a new type of clothes hook, illustrated at the left. Six hangers may be hung at once from its notched edge. The notches prevent hangers from slipping off or crowding together. Only three such hooks are said to be sufficient to equip an ordinary small close

Lighten Home Tasks

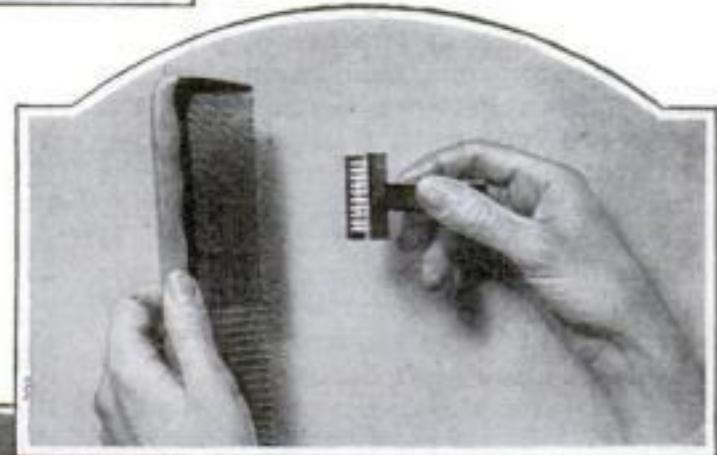


For that hasty morning shoe shine, here's an outfit that will save the furniture and your back. Around the foot rest runs a wire bar. Passed over the shoe and under the bar on either side, the polishing cloth can be handled easily from an erect position



A marvel of compactness, the novel "housekeeping cabinet" above is equipped with a two-burner electric stove, adjustable electric light, bread box, linen and silver drawer, even a folding table and ironing board!

With a new thermometer for fireless cooker disks (below) you can turn off the gas the instant the stone is at the proper temperature



Clamped on the corners of the bridge table, these useful trays keep glasses and ash trays out of the players' way. They are attachable, also, to desks as well as to flat-arm chairs



One lump or two? It's daintily done with the spring tongs built into the lid of this novel sugar bowl, so that you lift tongs and lid at once. The sugar, too, is better protected from dust



A detachable mop wringer, adjustable to any size pail, is a new aid in floor mopping. To use it, rollers are pressed together with the foot and the mop is pulled through easily with the hand



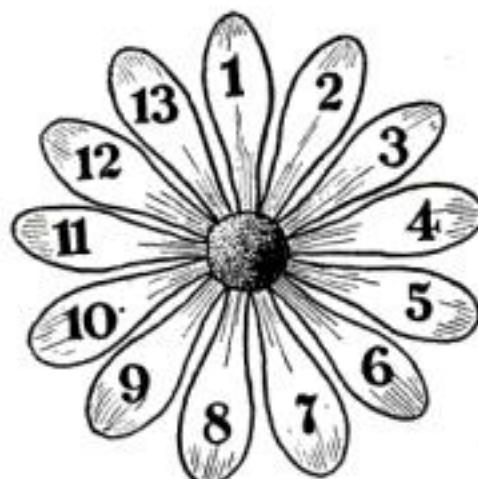
Two sets of bristles are the feature of this novel comb cleaner. When you squeeze the handle, tufts of bristles run through the comb from each side, leaving it clean



A "zipper" fastener is a feature of a new wardrobe bag, closing the bag tightly against dust and insects. A wire frame holds the bag rigid

Sam Loyd Offers Six New Tests of Your Wits

Brain-Teasers to Show Whether Words, Facts or Figures Are Your Forte



Are You a Good Strategist?

HERE'S a new version of the daisy game of prognosticating your matrimonial future by plucking the petals of a flower: The game is played by two persons, who take turns plucking the petals. At each play the player is privileged to remove any one petal from the circle, or two petals, provided they be contiguous, none having been removed from between them. Thus the game proceeds until finally one player removes the last petal and leaves the "old maid" stump for his or her opponent.

Of course, the strategy of each game is affected by the chance numbers of petals to be dealt with, but for the purposes of our mental test we will assume that the full-fledged daisy has thirteen petals.

If you were starting a game with the daisy of thirteen petals and your opponent, having first play, removed petal number 1, what would be your best play in reply? Which has the advantage, the first or second player? The answer and your rating are printed on page 141.



Are You Quick at Figures?

JOHNNY performed his example in multiplication; then he made a little puzzle out of it, as shown above, by erasing thirteen of the figures and challenging the family to discover his multiplier. Sister Kitty "cooked" Johnny's problem by discovering that he might have used either of two multipliers to work out consistently with the evidence on his slate. Can you duplicate Kitty's feat?

If you are quick at figures you'll follow up the clues easily. Turn to page 141 for your rating.



Do You Spot Clues Quickly?

SCAN for a moment the determined physiognomies of the Young Giants, gallant team that carried off the First Ward pennant under the inspiring leadership of Snubby McCann. In the picture, they are arranged according to their ages. They are exactly six months apart—increasing by half-yearly jumps from the first to the ninth. The total ages of the first five players equals seven eighths of the combined ages of the last five.

Snubby is the smartest sixteen-year-old diamond strategist in town, so see if you can identify him from the information at hand. To see how you rank as a deductionist, turn to page 141.

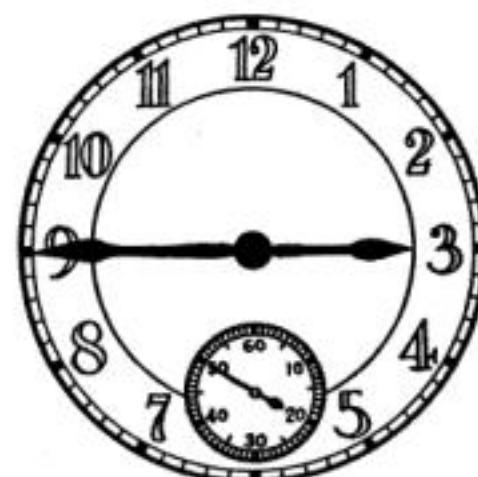
Can You Find the Right Words?

SAID the ant to the cricket, when the latter made his usual prewinter bid for a loan: "Do not think to find me a foolish — fellow — of your self-inflicted troubles. I — you are a — little chap, with a charming voice and a — mind, albeit you are somewhat of a — and — in your speech."

"Why you let the springs of industry lie — in the — season, when there is — work for all of us, I — understand. You must — that misery and — are invariably — upon improvidence. Nevertheless, I shall not be entirely — to your appeal. On the way out of my garden you may stop at the — and slake your thirst."

Can you complete the ant's homily by placing in the blank spaces appropriate words ending with "ant"?

If you are possessed of a generous vocabulary and a faculty for quickly producing the words which most aptly express your thoughts, you should solve this without much mental agitation. Turn to page 141 for your rating.



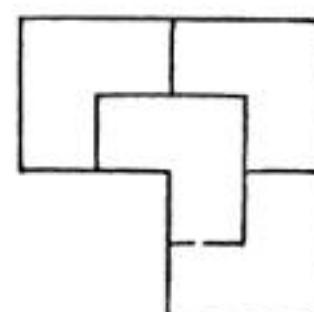
What Was the Correct Time?

IN A recent holdup a bullet struck the face of a clock, hitting the exact center of the dial, driving the post of hour and minute hands through the works and instantly stopping the clock. The hands were fixed in a straight line, though not as shown above, for it is evident that a correct time is not indicated. It is assumed that the hands spun about after being welded together by the bullet.

It proved quite a problem for the authorities to prove what the exact time must have been, not neglecting the clew provided by the second hand, and assuming that the three hands were running in perfect coördination. Can you do it, too? Time yourself, then find your rating on page 141.

A Test of Organizing Ability

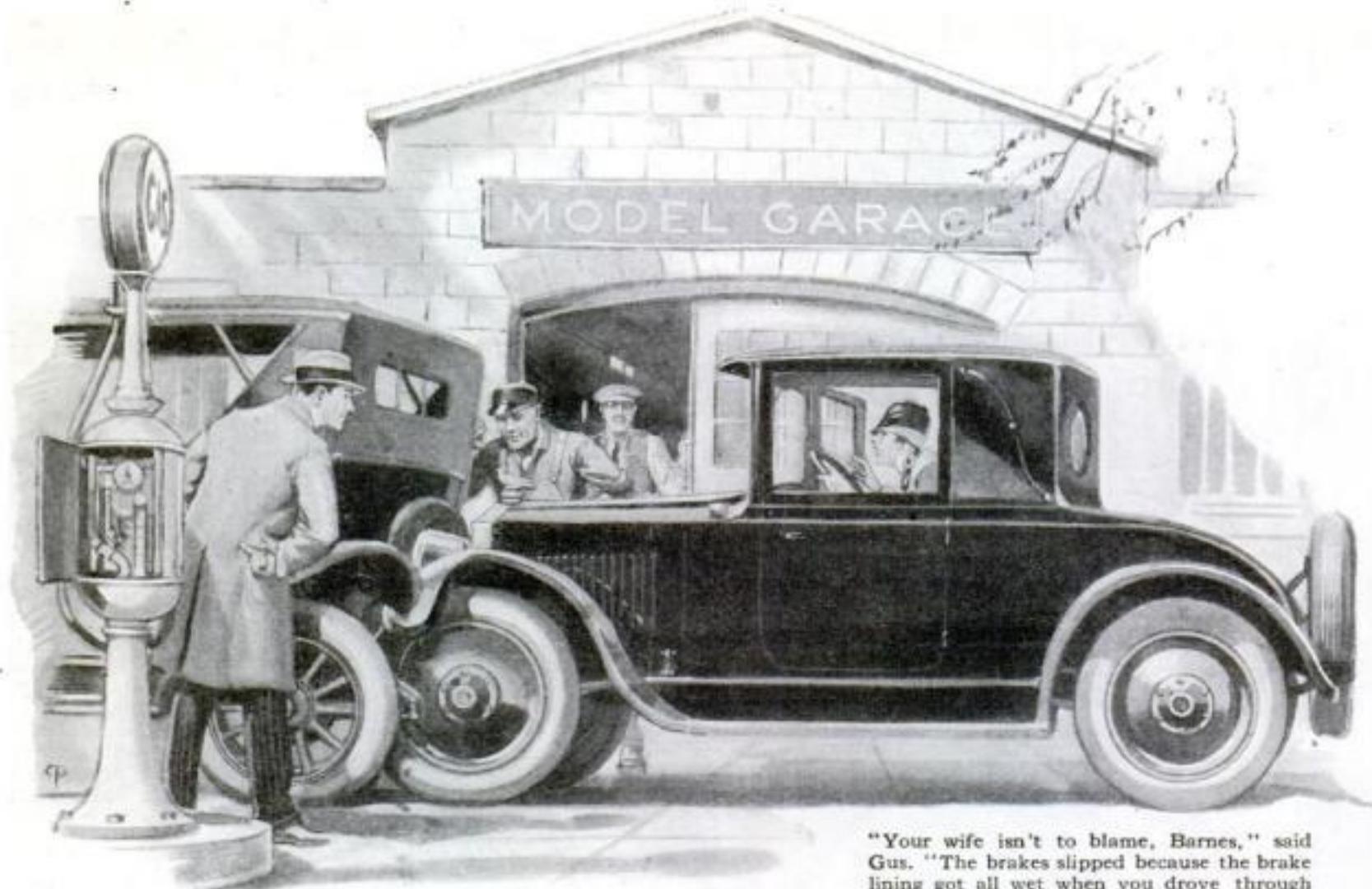
THE figure below, taken as a whole, is composed of three similar squares. Each of the four sections into which it is divided is likewise composed of three similar squares.



It illustrates how a planter bequeathed his land to four sons, treating all exactly alike. Now, the total number of square miles in the big tract was the same as the number of linear miles of fencing that inclosed and divided it into the sections. The problem is: How many square miles of land did the planter leave his boys?

Here is a test of your ability to grasp visually and organize the factors of a concrete proposition. Time yourself, then turn to page 141 for your rating.

Sam Loyd, author of these entertaining and instructive tests, is the world's greatest puzzle maker. Are you following this fascinating page of brain-teasers from month to month?



"Your wife isn't to blame, Barnes," said Gus. "The brakes slipped because the brake lining got all wet when you drove through that big puddle down the street!"

When Your Wife Learns to Drive

Gus Gives Some Pointers for the Woman Motorist

By MARTIN BUNN

NOW I suppose we'll have a little peace and quiet around here," Gus Wilson grumbled to his partner, Joe Clark, as the latter finally stopped hammering on the fender of his flivver. A truck had side-wiped Joe's car on the way to the Model Garage that morning.

"Aw, quit beefing!" snapped Joe. "It's got to be fixed sometime, hasn't it?" But Gus was doomed to disappointment, for the next moment the two garage men were startled by the sound of a crash, followed by the tinkling noise of broken glass. Dropping their tools, they rushed for the door. Directly in front of the garage a car had rammed into the rear of another car parked at the side of the road. The force of the collision had been sufficient to smash both headlights and wreck the spare tire rack on the parked car.

"Now you've done it! Didn't I tell you to put on the brake?" the owner of the car was shouting, hopping about excitedly.

His wife was still sitting behind the wheel. "But I did put on the brake as hard as I could, Dick," she protested. "It just didn't hold!"

Gus, who had been examining the brakes, now walked around to the front. "Your wife isn't to blame, Barnes," he

asserted positively. "The brakes did slip because the brake lining got all wet when you drove through that big mud puddle down the street, and when the brake lining is wet it doesn't hold near so well as when it's dry."

"Sure, I know it doesn't," admitted Barnes, "but that only means you've got



What Was Wrong with Spratt's Car?

IN THE December issue we published a story detailing the troubles of Henry Spratt with a secondhand automobile in which he and his wife had started out on a long tour. We offered a prize of \$25 for the best letter explaining the trouble with Spratt's car and telling him how to overcome his difficulties.

Guy F. House, of Lost Springs, Kansas, wins the prize. The vacuum tank float in Henry's car was leaking, and many contestants demonstrated their knowledge of auto mechanics by indicating this as the source of trouble. Only two out of the entire number, however, instructed Henry to turn his carburetor back to its original setting and showed him how to get to the nearest garage. Of these two, Mr. House, in the opinion of the judges, offered the most accurate diagnosis of the trouble and the simplest and most effective way to proceed.

to press a bit harder on the pedal. It's no use," he growled, shrugging his shoulders. "She'll never learn how to drive a car in a thousand years! It makes no difference what I tell her, she does exactly the opposite."

"Is that so!" snapped his wife, who by this time had recovered somewhat from the shock of the accident. "If I can't drive, whose fault is it? You just keep nagging at me until I get so fussed I don't know what I'm doing!"

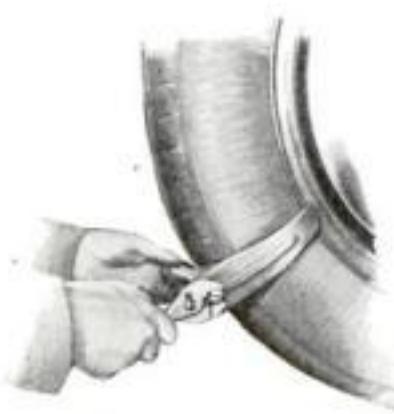
"Seems to me it isn't all your fault at any rate, Mrs. Barnes," suggested Gus mildly, in an attempt to stop the family scrap that threatened to develop. "In the first place, I notice that you haven't any cushion at your back and as you are not so tall as your husband, you can't reach the pedals properly or push them hard enough."

THEN it's always bad dope for a man to try to teach his own wife how to drive. No wife likes to play the dumb-bell before her husband, so she won't admit she doesn't understand everything he tells her the first time. She makes mistakes. He becomes impatient and sarcastic and the war is on. Besides, just because a man happens to be a good driver himself is no guar-

(Continued on page 142)

Practical New Aids to Motorists

Syphon Oil Bottle, Gripper Mud Hook, Socket Wrench Set and Other Handy Time-Savers



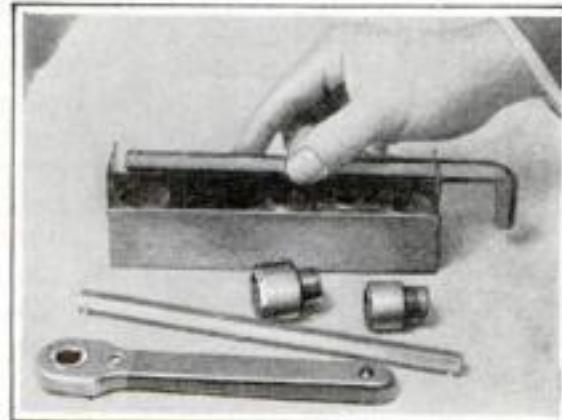
Here is a mud hook that will pull you out of a hole with ease. It consists of a heavy, ribbed cross member with hinged side arms controlled by a bolt, so that the hook can be clamped around the tire to the edges of the rim



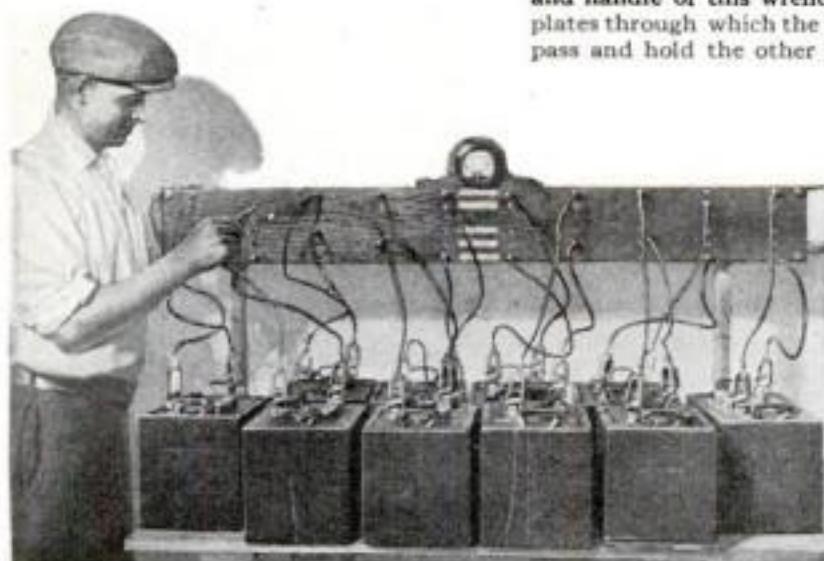
One pull on the plunger of this special gasoline tank syphon starts a steady stream flowing into the tank of the camper's gasoline stove, or into a can to help out a stranded motorist



Spring oiling is a dirty, disagreeable job when it means crawling under the car with an old paint brush and a pail of waste engine oil. This new pressure oil container filled with a special penetrating oil makes the job easy and quick. A knurled wheel opens a tiny hole through which the oil is projected in a fine stream with so much force that it can be directed accurately from a distance of several feet, as above



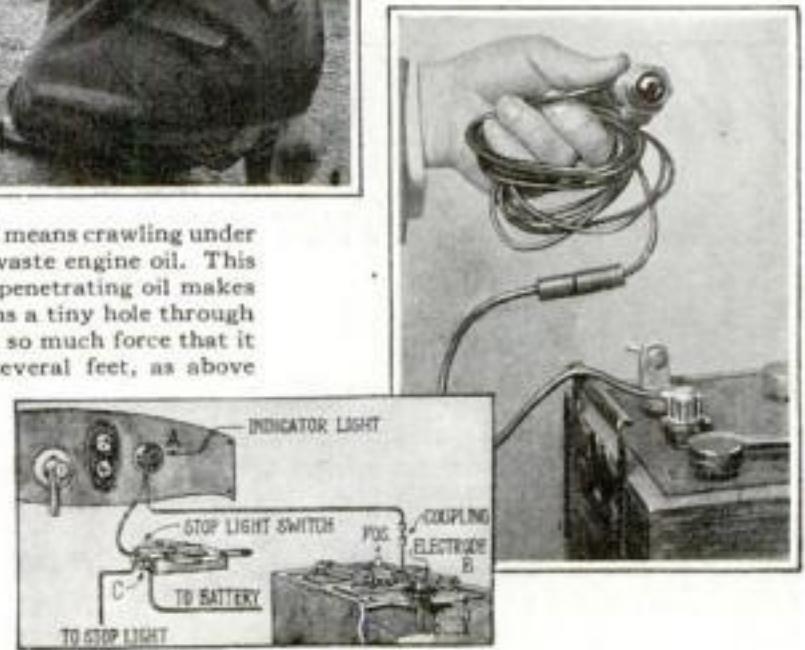
The metal tray into which the sockets and handle of this wrench kit fit has end plates through which the hexagonal pieces pass and hold the other parts in the tray



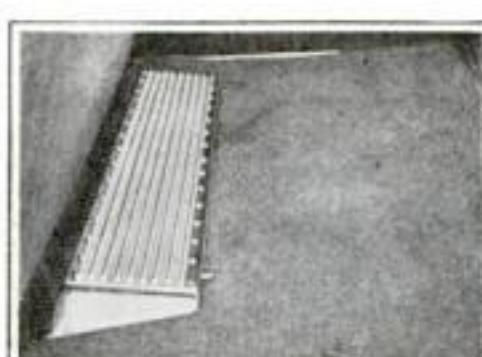
This new battery charging panel simplifies the work of the battery service station. Instead of using clips or knife switches, a row of jacks is provided with plugs on the cables. The upper row of jacks is connected directly to the constant voltage charging generator. The second row gives ammeter readings



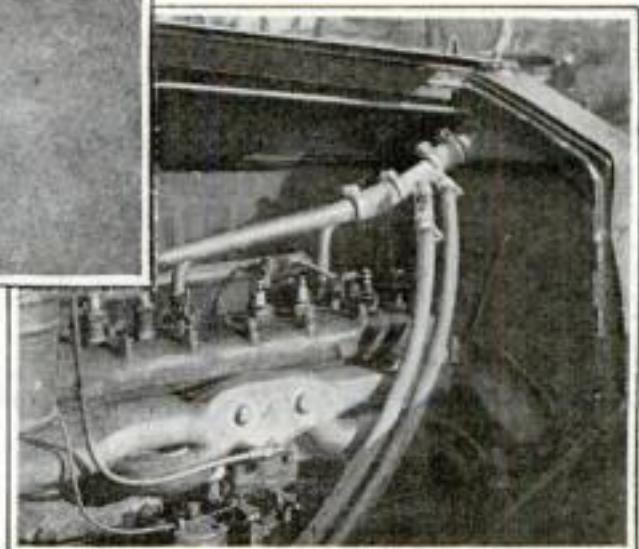
The tail-light of an automobile is in constant danger of damage because of its exposed position. Special tail-lights built of rubber with flexible celluloid-covered apertures (above) were shown at a recent auto exposition. The rubber is soft and flexible so that the tail-light bends when struck



Most automobile starting batteries are allowed to run low on water through forgetfulness on the part of the owner. This novel indicator automatically tells when the level is getting too low. When wired as shown in the diagram, the red light on the dash will flash on each time the brake is put on if there is still sufficient water in the battery. When the level falls too low, it no longer makes contact with the lead plug in the filler cap



Here is a new hot water heating system designed to supply even, uniform heat. The radiator is installed behind the front seat and connected by pipes to a fitting that takes the place of part of the top hose connection. A valve controls the flow of water



"No one could make Stradivarius violins by mass production"

Thomas A. Edison now answers a questionnaire

FROM his laboratories Thomas A. Edison has from time to time issued questionnaires. Now, he has consented to become the interrogated—has agreed to lay bare his half-century of effort to give the world perfect Re-Creation of music.

In plain, untechnical words, Mr. Edison here tells how he has made a marvelous musical instrument with all the painstaking care and individual detail of a Stradivarius Violin.

The questions asked Mr. Edison were:

Ques. Do you take advantage of the economies of mass production in the making of your phonograph?

Ans. I consider the New Edison Phonograph a musical instrument and not a machine to be made in the manner of automobiles, cheap furniture or other things in which uniform quality is not a prime essential.

Ques. Isn't it possible to make instruments of standard quality by mass production?

Ans. No greater proof of the fallacy of this, as far as phonographs and other musical in-

struments are concerned, can be offered than the vain efforts of violin manufacturers to make violins of Stradivarius quality by mass production. For although every part of the instrument may be exactly alike as to size, unless there is the individual human touch, there is bound to be a variation in tone quality.

Ques. How can the layman tell the difference between a phonograph made by mass production and one made by craftsmen?

Ans. Anyone is apt to be satisfied with existing conditions until he hears something better; may even excuse distorted tone for want of a superior instrument. But when an ordinary phonograph turned out in quantity is compared side by side with one in which human hand work has played its part, the glaring difference instantly is apparent.

Ques. What do you consider the truest test of phonograph quality?

Ans. There is no measure of tone quality like the human ear. For this reason I urge comparison between the New Edison and other phonographs.

To this end, I have advised every Edison dealer to place—with obligation to the prospective buyer—the

New Edison in any home where comparison with other types of phonographs is desired.

Ques. How would you describe

Like a Craftsman of some old world guild, like Stradivarius in his workshop, Edison craftsmen individually make each New Edison Phonograph.



The NEW EDISON PHONOGRAPH

WATCH FOR OTHER QUESTIONNAIRES BY MR. EDISON

the tone of the New Edison Phonograph?

Ans. It is sheer nonsense to speak of the tone of a phonograph or of its resonance. A phonograph should have no tone of its own. The instrument should be *only* a medium of Re-Creation. Obviously you should be unconscious of it and hear only the beautiful music it Re-Creates.

I worked for five years and spent more than \$3,000,000 in experimental work to remove any false tone from the New Edison. Even when I, myself, was satisfied with the results I did not stop there. I insisted that the New Edison be submitted publicly to the test of side by side comparison with living artists whose performances had been recorded. Exacting music critics could detect no difference between living and Re-Creation performance. ★

Why There NEVER Can Be a Better Phonograph

After all, the phonograph serves but one purpose—to Re-CREATE voice or instrument with human reality. When a phonograph does this, nothing more can be asked—it has reached perfection.

That the New Edison Phonograph achieves this is fact—not theory nor hopeful expectation. During more than 5,000 tests in Carnegie Hall, New York, Symphony Hall, Boston, and in other noted music centers, side by side tests were made with living artists who sang or played before a critical public in direct comparison with the New Edison Phonograph.

Eminent musical critics who attended these tests found it impossible to detect the living voices or instrumental performances, from the New Edison Re-Creation. Thus it was proved that the New Edison Re-Creates with literal fidelity and in a way that baffles the keenest ear in the effort to detect the living performance from the Edison Record.

Hear the New Edison Phonograph today at your nearest Edison dealer's—also get him to play one of the Edison 40-minute records—the inventor's latest achievement—a record no larger than the usual short playing record

which permits you to enjoy without interruption a complete concert on one double-faced record.

The New Edison has always sold by comparison—compare it yourself with any other phonograph and let your own ears decide.

OK
Charles Edison



Buy separately or in assortments



What every garden needs

IS your garden merely a growing place for grass, trees, flowers, or vegetables? Does it offer you an inviting place to rest?

The whole family will use and appreciate a comfortable garden seat. It is so easy to make a garden seat that no garden should be without one or more. Stanley Plan No. 21-E gives complete details for making such a seat.



Confidence in your tools will make any job more enjoyable. The amateur user needs good tools even more than the professional. Stanley Tools can always be depended on, as nearly every American carpenter knows. Thousands of manual training instructors use Stanley Tools in their classes. The Stanley name on

a tool is your assurance of durability, correct design, and right "feel."

You can buy Stanley Tools separately and so collect your own set. For your convenience in buying there are also complete sets of Stanley Tools in chests at a wide variety of prices from \$15 to \$95. Or there are assortments in strong cardboard boxes containing directions for making your own tool chest. Price \$5.00 to \$20.



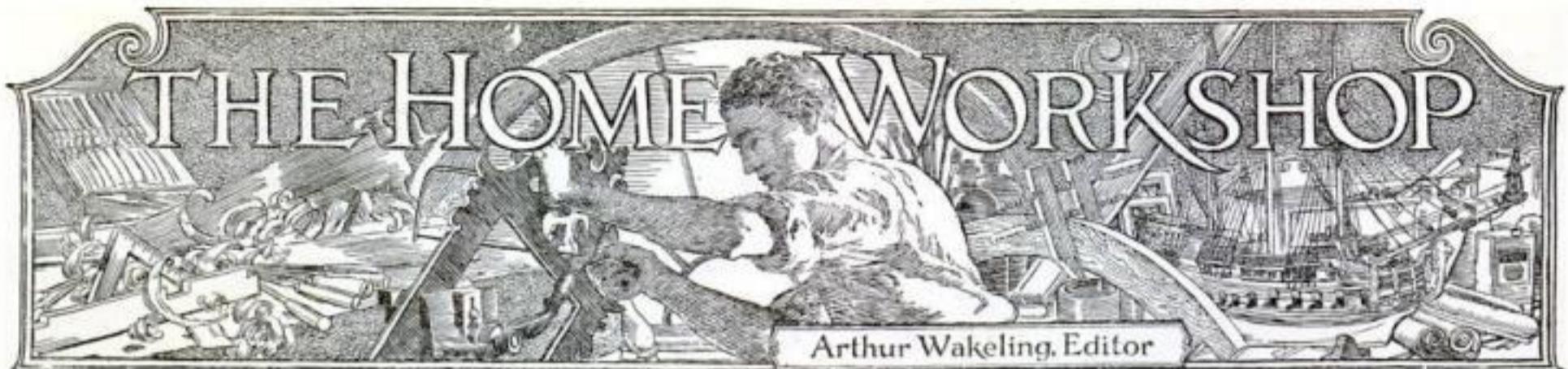
Your hardware dealer has Plan No. 21-E as well as other Stanley Plans for making useful articles, or he can get them for you. The plans cost only 10c each. Ask him also for Catalog No. 34-E which shows the most complete line of woodworking tools on the market. It is free. If he cannot supply you write to The Stanley Works, New Britain, Conn.



The best tools are the cheapest to use
Ask your hardware dealer



STANLEY TOOLS



New Uses for Plastic Paints

*Building an Ornamental Fireplace without Masonry—
A Treasure Chest—Walls and Ceilings—Other Novelties*

By E. M. OREN

AS A RESULT of Eleanor's insistence, we had redecorated the walls and ceilings of three of the rooms in our house with rough texture and color effects.



Touching up the keyholes of the treasure chest with black.
The lock plates, hinges and straps are of plastic paint

How we accomplished it I told you in an article in the January issue. Briefly, we decorated the walls of our living room in Spanish texture, the walls of our dining room in Italian style, the ceilings of both in a monastic finish, and the kitchen in a Colonial stipple.

Now, to do all this we used "plastic paint," a material in white powder form, that is bought at the paint store. It is mixed with water, first. Then color is added, either mineral pigment or good oil color, until the desired shade is reached. A large brush, such as a Dutch calcimine brush, is used to apply the plastic paint on the walls. While the plastic paint still is "tacky," the rough texture is developed. The back of a kitchen spoon was used to develop the Spanish texture. The Italian texture was developed by leaving the

brush marks showing and then smoothing them down with the palm and the heel of the hand. The monastic texture was made with a four-inch wall brush only, and the Colonial texture was obtained with a painter's ordinary stippling brush.

I had planned to tell you first in this article how we decorated the other three rooms and the hallway of our house with plastic paint. But between writing the first article and this, Eleanor decided that what we needed in our living room was a fireplace. So we made one—with plastic paint. There is a picture of it on

The first thing I made was the frame, for which I had enough scrap lumber in the basement. And I can explain in a diagram (page 79) how this was made much easier than I can in writing. After the frame was finished, it was nailed to the wall and covered with gypsum (plaster) wallboard.

Next the joints of the wallboard were reinforced with strips of strong fabric, purchased with the wallboard. To cement the joints plastic paint was used. First, the joint was "buttered" with a thick



A fireplace
of wood, wall-
board and
plastic paint.
The small
chest on the
mantel and
decorative
panel above
were stenciled
with
plastic paint



Glass, pottery and wooden objects
with plastic paint ornamentation.
The candlesticks and bowl are
blue; the stenciled bonbon dish
is silver; the vase is bronze

this page. One would hardly attempt to build a fire in it, because it has no chimney. But it does add materially to the appearance of our living room, and it was more than simple to make.

mixture of plastic paint. Then the fabric was pressed lightly along the joint. Next a semiflexible putty knife was drawn down the joint with sufficient pressure to force the plastic paint up through the mesh in the fabric. Nail heads then were "spotted" with plastic paint. After the whole had dried, the joints and nailheads were lightly sandpapered.

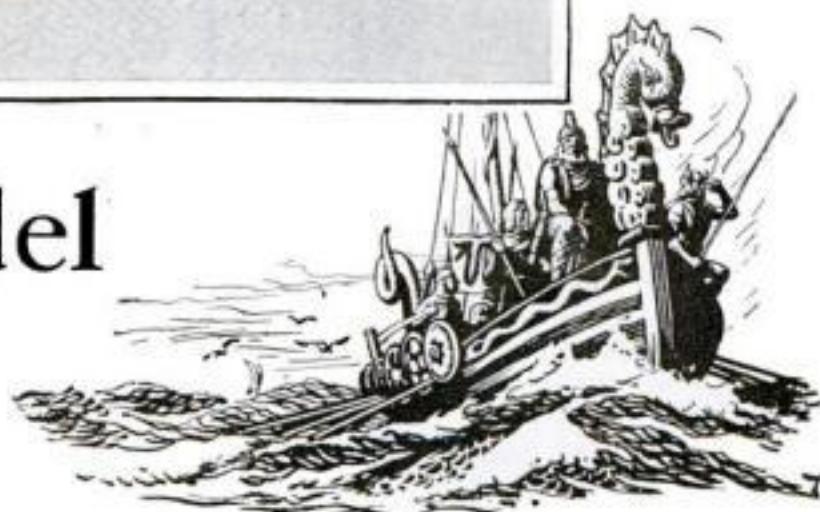
The fireplace then was ready for decoration. The plastic paint was mixed in the usual way, applied over all surfaces and stippled with a stippling brush. A draftsman's triangle was dragged lightly down the surface to flatten some of the stipples. Keystone, cornerstones and (Continued on page 78)



Simplest of all our historic ship models—a brilliant and charming decoration—may be finished in brilliant colors

Blueprints with full size details of all parts are available for this romantic model, which requires little technical skill to construct

Here Is a Ship Model All Can Build



This Colorful Viking Vessel Is Easy to Make and Is Inexpensive—The Materials Cost Two Dollars or Less

By CAPT. E. A. McCANN

Gothmund spoke:

"Swift keels lie hard by the land,
(Mast-ring harts and mighty yards,
Wealth of shields and well-planed oars;)
The king's fair host, the Yfeling's haughty;
Fifteen bands to land have fared,
But out in Sogn are seven thousand.

"At anchor lying off Gnipalund
Are fire beasts black, all fitted with gold;
There wait most of the foeman's men,
Nor will Helgi long the battle delay."

—EDDIC POEM

THE time is some eleven hundred years ago and the scene the rune-carved ancestral hall of Varin on the shores of Varinsfjord in Norway.

Varin is growing old. He is rich in everything but land. His hall is replete with gold, fine fabrics and great treasure of other lands, but his odal is small.

Therefore on this day he gives one of his skutas or dragon ships to his son Lief, telling him to go forth and carve fame and fortune for himself.

Lief, eager for the word like a mettled stallion, gathers around him seventy of the young men clamorous to follow him in

Viking voyages of adventure, discovery and acquisition—to visit friendly jarls, hostile countries or unknown lands—to return with gold and wives.

Lief's ship was a war vessel, distinguishable from a merchant craft by her longer lines and ornamentation. She was called variously a skuta, a long-ship, a dragon ship, or a long serpent. Her extreme length was 79 ft., the breadth 16½ ft., and the displacement or weight with fittings about 20 tons.

She was slim, but very sturdy and seaworthy. Her object was, with oars and sail, to strike swiftly and hard and to withstand the knocks of an enemy or the battering of the fierce northern gales. His ship was not only useful, it was exceedingly decorative, with its carvings and its black and gold color scheme.

Unfortunately, we cannot ourselves go visiting and raiding with Lief, but from authentic data available we can build a model of such a vessel as he used. Those who care to follow carefully the instructions given here can make a dragon ship model without much difficulty and with

little or no expense. Even if all the materials and paints are purchased, their cost should be well within two dollars.

The main dimensions and details of the long-ship or war vessel here described are based on the actual Viking ship which was discovered in 1880 lying in a tumulus, or grave mound, at Gokstad, Norway. This ship is preserved at the University Museum, Christiana. Some details of our model are from a merchant ship found at Oseberg and others from the Nydam ship, as well as from the Bayeux tapestry and the Eddic Sagas.

IT IS proposed, however, to simplify the construction, so that, while retaining the correct dimensions and appearance, any reasonably handy person can make the model from easily obtainable materials with such tools as are to be had almost anywhere.

To make the building of the model still easier, two blueprints have been prepared with full size drawings of all the parts and a complete list of materials. These you can obtain by sending 50 cents to the Blueprint Service Department of POPULAR SCIENCE MONTHLY for Blue-

prints Nos. 61 and 62 (see page 92). Now to work! Instead of laying a keel and on it erecting stem, sternpost and ribs and to these building up the sides, plank by plank, which is tedious and difficult work, we take a piece of $\frac{1}{4}$ -in. three-ply wood $20\frac{1}{2}$ in. long by 6 in. wide and from it cut our keel, stem and stern in one piece. This we shall call the centerpiece. It is shown on page 88 and is indicated by the heavy outline on blueprint No. 61.

Those who have not a fretsaw will be well advised to buy one, as it will be handy all through the work. It should have at least a 12-in. bow and may be purchased at any hardware store, with blades, for about a dollar. However, this and the other pieces can be cut with a much cheaper and smaller coping saw.

BEFORE we go any further, it will be noted that the centerpiece extends well into the body of the vessel at the bow and stern; these two portions lie under the fore and after decks, which are built up solid. Those who prefer and have the skill may cut away these corners of the centerpiece to an even curve and later build up the bow and stern lockers and decks; indeed, this method is rather better, but is more trouble. If you do this, the corresponding corners will also have to be cut away from the side blocks, which are to be described next, leaving the boat hollow from end to end. Retain sufficient wood at the ends for gluing and nailing.

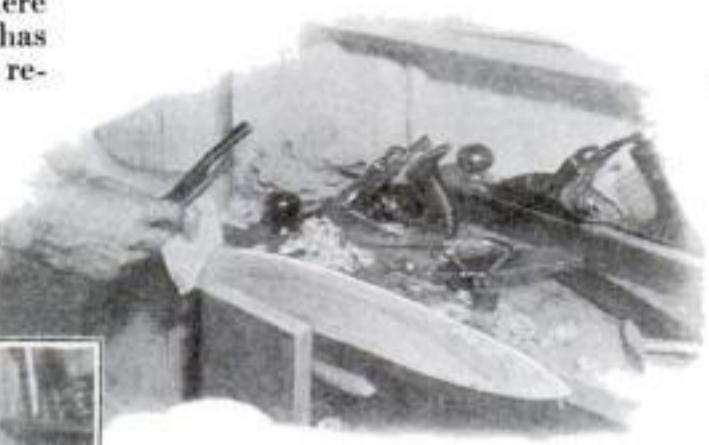
Next to be made are the two side blocks, which form the body of the hull. Each piece is designed to be made from a piece of $\frac{3}{4}$ -in. pine or other soft wood glued to a piece $1\frac{1}{8}$ in. thick. These thicknesses are easily obtainable from any lumber

easier to see just where one is laying the plan. Then, after the tracing has been pinned down to the wood in several places, the carbon paper is slipped between it and the wood.

The waste wood now should be cut away to these lines until the block will lie accurately on the blueprint or plan. The blueprint shows the starboard (right-hand) side; the other will, of course, be in reverse. There is a slight difference between the bow and stern ends. Here again the tracing is handy because it has only to be turned over for marking reverse sides.

On the top edge of the blocks mark the outline that is equivalent to a deck plan. With saw, chisel and spokeshave, cut away the waste to

On the amidship or flat side mark the sheer line; this is the curve which makes the ship higher at the bow and stern than elsewhere. Cut to this line, testing occasionally with the try-square so that you do not get lower on the outside than the inside. A saw cut or two down to the mark will help in digging out this curve. Note that the stern is a little higher than the bow. The spokeshave is the best tool



How to use cardboard templets for testing the shape of the side blocks of the hull

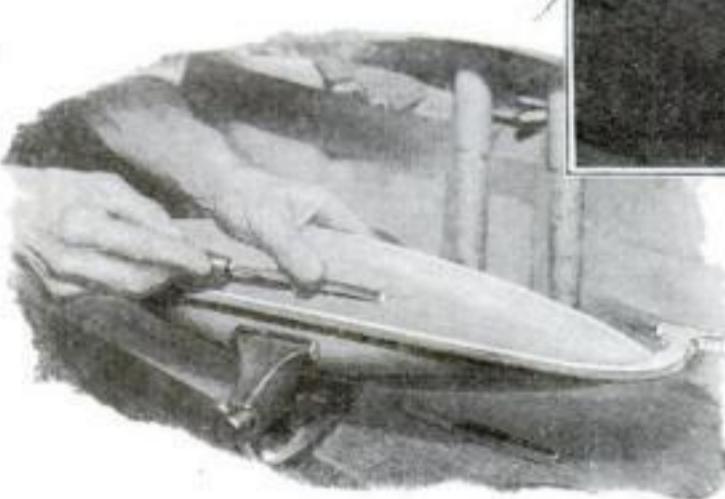
for this work. Lacking a spokeshave, one can make a good, sharp jackknife serve for this and most other tasks.

Now lay the blocks on the blueprint or your own full size drawing and mark on them the construction lines I to VII. Carry these lines carefully right around the blocks. From the body plan given on Blueprint No. 61 or the diagrams shown within squares on page 88, make a series of thin cardboard templets. Mark on each the corresponding number.

Grip a block by one end, bottom up, in the vise, or with the flat midship side face down on the table and proceed to shave away the outside until the templets fit to it, as in the upper illustration on this page. Start in the middle and do not attempt to bring the block down to the templets, at their position, one at a time, but shave along the whole length so that they fit almost simultaneously, thus preserving the long flowing lines with no sudden hills or hollows. Leave enough stock on for sandpapering the surface smooth.

A SMALL wooden spokeshave (blade about $1\frac{1}{2}$ in.) is the handiest for this work, but it can be done with a small plane, or even with a jackknife. Note when cutting that you hold the templets at a right angle to the hull, each at its corresponding construction station (I to VII) and with the keel and deck marks coinciding with the actual keel and deck lines. Be sure that you do not cut away anything more from those two lines, which you previously marked and cut so carefully.

These pieces can be roughly hollowed more readily before they are glued to the centerpiece than after. Therefore, $\frac{1}{4}$ in. from the curved edges, along the top and the flat side, make a pencil mark. Saw down (as suggested in the small illustration on page 89) *(Continued on page 88)*



The planking is represented by scoring lines with a jackknife and cutting long, shallow grooves with a chisel

dealer. One solid piece or layers of other thicknesses will serve equally well, provided their dimensions are at least $2\frac{1}{8}$ by $2\frac{1}{2}$ by 19 in. each.

On one side of each block mark the profiles for cutting. These and other lines may be transferred to the wood by making full size drawings from those on page 88, or, more easily, from the blueprints, where everything is given in full scale. You can trace the outlines through a piece of typewriting carbon tissue, but I prefer to trace them first on to tracing paper because with this it is so much

Captain McCann shows how to finish hollowing the hull with a gouge after the centerpiece and the side blocks have been glued securely together

these lines, but do not cut too fine at the extreme ends, because if the points are bruised and broken, pieces will have to be built in to renew them.

Holding the blocks of wood while working on them is no trouble if one has a bench vise. One should certainly have a vise for ease in doing most carpentry jobs. If, however, one has no regular bench, it is worth while to buy a small iron vise which may be clamped on to a table. In the absence of a vise of any kind, I suggest cutting a V-shaped notch in a piece of plank and fastening it on to the table with a C-clamp or hand screw to act as a stop. Cut a wedge to fill half the notch; then either end of a side block may be held firmly by pushing it and the wedge side by side into the notch.

You Can Build This Armchair

A Cross-Legged Seat That Is Remarkably Comfortable—Inexpensive to Make, but of Rich and Costly Appearance

By CHARLES A. KING

"WHEN we get tired of auto tripping, I do hope we can have a camp or bungalow as well planned and furnished as this!" exclaimed Mildred. "I have never sat in a chair that seemed quite as comfortable."

She leaned back contentedly in the roomy folding armchair and smiled at Helen and Val.

"I am glad you like it," responded Val, "for I had considerable difficulty in persuading Helen that we wanted just that kind of chair. Now we both feel that we could have found nothing more satisfactory."

"I don't think you could," agreed Jimmie, Mildred's husband. "They are seldom appreciated, yet it seems to me that no chair is quite so easy to drop into."

"I think," laughed Val, "that the man who invented the chair is a public benefactor and hope that he has had no trouble in collecting adequate remuneration."

"WELL," rejoined Jimmie, who was an interior decorator, "if he had not collected his just dues a couple of thousand years ago, I think he would have trouble in establishing his claim today, for these chairs are lineal descendants of the Roman chairs which were common before the days of the Caesars."

"I supposed they were a modern product," said Val. "What is the connection between the Roman chair and these?"

"You had better not get Jimmie started on the evolution of furniture," warned Mildred, "for that is his particular hobby and he will talk on it all night if he has the least encouragement."

"Good!" ejaculated Helen and Val in concert.

"That will be just fine," Helen added, "for we are buying pieces as we happen to find them—for our new house at Bramere. Now, Jimmie, we want you to tell us just what a Roman chair is and the process of its evolution to the folding chair."

"Well," Jimmie replied, "if elegance of design and workmanship were the basis of evolution, I should say it was a case of devolution instead. As compared with

this camp chair (A, on this page), the Roman chair (B, page 90) was made of a number of pieces of wood from one and a half to two inches thick, shaped to a compound or reverse curve and held together with an iron rod. It was not particularly a folding chair, but its form easily suggested that adaptation. It was a heavy

"The type was common in Italy during the middle ages. It is often called a Dante or Savonarola chair. In one form or another the chair has appeared in nearly every European nation whose cabinetmakers were skilful enough to produce them. We find modifications of the Roman designs in old Spanish furniture (D) and in Flemish, German and English (E), more especially during the Tudor period of the sixteenth century.

"EXCEPTING the Italian pieces, most of these modifications were of four heavy legs, either rigid, folding or semifolding. The type received little attention during the seventeenth, eighteenth and early nineteenth centuries, which saw the inception of our modern furniture. This explains why you do not see the type in our early American pieces. Designers and cabinetmakers gave their attention to styles favored by reigning houses or the styles of designers and makers who for the time held the public fancy, Chippendale, Heppelwhite, Sheraton, Phyfe and others. They designed no furniture based upon the cross-legged motive, though in some cases it was suggested.

"It has remained for modern furniture designers to rehabilitate the cross-legged idea in making chairs. They are often used in fine homes, especially of the California and Florida types, where the rough plastered or plastic paint walls form an ideal background for massive furniture.

"Today we seek for any type which may be adapted to modern needs. For example, look at this—"

Here Jimmie reached into his coat pocket and produced a sketch-book, his inseparable companion. In it were many original sketches and memoranda of furniture, including the drawings for the chairs marked F and G (pages 90 and 91).

"While the cross legs of this chair (F)," Jimmie explained, "are halved in the center and fastened together rigidly, the method of fastening the rounds with bolts and screws (Continued on page 90)



Cross-legged armchair with Spanish leather seat and back, which Val planned to make. The working drawings are given on page 91

This type of folding camp chair, referred to as A in the text, is a lineal descendant of chair B on page 90

and clumsy piece of furniture, which was perhaps the reason why, in its evolution to the Italian Renaissance, its shape (C) was changed in the direction of lightness and economy of material. Then it became necessary to make a seat instead of merely shaping the legs to fit the body or to receive a cushion.

What's wrong with this Picture?



John and Mary have started on a day's picnic. But with the hard luck that has followed John he has just got nicely started when a front tire goes flat.

MOST of the readers of Popular Science Monthly will know what he is doing wrong. The picture shows him wrestling with his punctured tube—trying to patch it with a piece of rubber and some cement. It will take him half an hour or so—and when he does get his tire back on the wheel and the weight of the car on it he may discover, like thousands of others, that his patch doesn't hold air and it may be necessary for him to go through the same sweaty performance again within a few miles.

The readers of Popular Science Monthly have helped John and Mary in many of their difficulties. If they were there they would tell John to stop in the next town at any place where auto supplies are sold and get a Shaler 5-Minute Vulcanizer Outfit so that the next time he had tire trouble he could make a permanent repair in a few minutes that would last as long as his tube.

Complete Outfit Costs Only \$1.50

Any tire repair man will tell you that to make puncture repairs last you must VULCANIZE with HEAT. That's why more than four million motorists use the Shaler 5-Minute Vulcanizer. It's the quickest and easiest way to fix punctures and make repairs permanent under conditions that would soon loosen any cemented patch—for instance in Balloon Tires. The Outfit includes Vulcanizer and 12 Patches—Patch and Heat Units—ready to use—only \$1.50 (a little more in Far West and Canada).

THE SHALER COMPANY, Waupun, Wis., U. S. A.



PRIZES FOR BEST ANSWERS

What's wrong in the picture beside the fact that John is not using a Shaler 5-Minute Vulcanizer?

To the fifty people sending in the best answers we will give FREE a complete \$1.50 Shaler 5-Minute Vulcanizer outfit with patches.

Completeness, correctness and neatness are the things on which winners will be judged.

Contest closes June 1, 1927.

Address

THE SHALER CO.
Waupun, Wisconsin

What My Shop Has Taught Me

How to Keep Bench and Tools in Order and Run a Lathe with a Salvaged Motor — Hints on Homemade Furniture

By HAROLD P. STRAND

SO MANY beautiful, useful articles can be made with a few tools, from a rough, shapeless piece of wood, that I just can't understand men who profess no interest in building or creating things with their hands. They miss a great deal in life.

My own desire to build things began early. As a boy of fifteen years, I undertook to construct a two-car garage for a friend. While I had a little help in the framing, the rest of the work I accomplished all alone. I shingled the roof, clapboarded the sides, hung the doors and windows and laid a 2-in. plank floor. Even today when I happen to pass the property with a companion, I take pride in saying:

"See that garage over there? Well, I built it myself when I was a kid in grammar school."

After the garage was completed, I cleaned away a corner of the cellar at home so I could put up a bench and have a little workshop. From that day to the



Mr. Strand in his workshop at Malden, Mass. He is rubbing down an old desk which has just been restored. Note the bench, tool rack and lathe

To derive the utmost pleasure from my hobby, I have found it essential to keep an orderly shop. It is no fun to go to your bench for an evening's work with your mind full of ideas and then to find a conglomeration of papers, shavings and tools lying about. The job of cleaning up, sorting out scattered tools and otherwise wasting precious time is to me such a discouraging beginning that I lose my eagerness and zest. So I think it is a good plan to spend a little time picking up after the evening's work, even if you have to quit work a little earlier. Give the next day a clean slate and an unhampered start.

THE place for the tools more commonly used is in a neatly arranged rack at the back of the bench, where each has its own stall. Then a vacant place tells of a mislaid or lost tool. The tool chest is all right for tools kept to meet unusual needs and for small odds and ends, but much time can be wasted by the man who keeps all his working implements tucked away in a chest.

To do good work, keep your cutting tools sharp with wheel and stone. Sharpen your saws or have them sharpened when they need it for otherwise they cannot do accurate work. The saws I have are the pride of my workshop. One of my saws belonged to my grandfather in England, and it holds its edge and cuts beautifully.

I find it necessary to have a pair of each of these saws: Rip saw, coarse and fine crosscut saws, fine tooth backsaw, compass saw and coping saw. The reason I have two of each is

because on particular work I like to "feel" the saw out and use the one that appeals to me for each operation. Two saws, even

of the same size and tooth, rarely "handle" the same; at least that is the way it seems to me. What a thrill one can get from the feeling of a sharp, well-set saw cutting its way with little effort through a solid, dry plank!

A saw vise, a three-cornered file and a saw set are indispensable. The saws themselves are kept hanging up when not in use, so nothing can cross the teeth and ruin the keen points.

It is a good plan to rub a little oil on them once in a while to keep the dampness from rusting them.

The sharpening wheel I used for years for grinding plane blades, chisels and other tools was one I made of bicycle parts. The crank hanger was the main drive, with the regular chain driving a sprocket on an old rear wheel, the rim of which made an excellent pulley. This received a belt, making the final drive to the grinding wheel shaft. The whole assembly was arranged in a hardwood frame with a seat for use while pedaling.

Recently, when the motor on our washing machine burned out, I bought a new one for the washer and then set out to rewind the old one for use in my shop. I charted the wire as I took it off and finally made a successful job of the field winding. This motor was a welcome addition. I have belted it to a wood-turning lathe, which formerly was operated by foot. *(Continued on page 92)*



Two toy rockers, a clothes rack and a chair made for the author's baby daughter

present my hobby has been my workshop.

I cannot begin to list all that has been accomplished or tabulate the amount of money that has been saved through this hobby. In our house, as in every other house, furniture has become damaged from time to time, a chair has required gluing up, or a table leg has suffered a blow. Perhaps the tea wagon has been left in front of a drafty window and the varnish become so checked that the piece must be refinished.

How many times cupboard doors have been found that needed planing! And countless screws and nails have been wanted here and there. Then there have always been new things needed that could be made at much less cost than their commercial equivalents could be bought.



The radio cabinet and piano lamp (above) are of solid mahogany. A handmade cedar chest is shown at the left



Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

PHOTOGRAPHS may be tinted or stained simply by immersing the prints in various salt solutions. In this process the main consideration is absolute cleanliness. All possible sources of pollution must be removed and the prints must be washed thoroughly in plenty of water after being removed from the bath.

As a rule the photos must be bleached before they will take the stain, especially those types of stains which can be made at home. A bleach may be made from 1 gram cupric chloride in 100 cc. of water (or a teaspoonful of the salt in a glass of water). As soon as the image has faded almost completely from the print, it is washed in water and placed in the tinting solution or bath.

If cupric chloride is not at hand, potassium bichromate may be used.

Make a saturated solution of the salt in water. To one part of this solution add four parts of water and two or three drops of hydrochloric acid for each glassful of the mixture. This is a rapid bleach, but it has one disadvantage in that the prints are, at times, tinged a slight yellow.

After bleaching, wash the print in water, allowing it to remain for a sufficiently long time to remove the salts.

A deep coppery tint is obtained on all places that were black, while the whites remain perfectly white, when a copper bleached print is dried in sunlight, or when dried and then exposed to sunlight. The shades produced are permanent.

To obtain a slightly browner tint, the bleached and washed print is bathed in a solution of 1 gram ferrous sulphate and 10 drops of dilute sulphuric acid in 100 cc. of water, or a half teaspoonful of the salt is placed in a glass of water and the acid just mentioned is added. Leave the print in the bath about five minutes, then wash, dry and expose to sunlight.

A pleasing sepia tone is obtained in a similar way by using a bath made by dissolving one gram of potassium oxalate in 225 cc. of water, or 1 heaped teaspoon of the salt in a glass of water.

A very dark reddish brown verging towards black is obtained by bleaching, washing and placing the print in the ferrous sulphate mentioned above; then washing and transferring it to the oxalate bath.

All these processes stain only the black or shaded portions. The whites are not influenced by the staining action. Old photos can be used just as well as new.



Mixing a solution for staining photographs



Shifter position (down) for right-hand ratchet.



Shifter position (up) for left-hand ratchet.

a glance shows whether on ratchet or rigid

WITH the "Yankee" Bit-brace you do not have to try the tool this way and that to find out *which way* the ratchet is set.

A glance tells the story: with *ratchet shifter* centered, the brace is rigid. When shifter is down, the brace is on right-hand ratchet; when up, left-hand ratchet.

You change the ratchet adjustment at a fingertouch—and you see what you are doing!

The "Yankee" Ratchet is famous for its easy action. Smooth, silent, powerful! Chuck is quick centering, accurate and will not loosen in work. Hard Rubber Handles do not warp, shrink, crack nor bind.

Try the "Yankee" Brace at your hardware dealer's. You will see the economy of owning the finest tool of its kind. Ask him to show you the *new "Yankee" Bit Extension*.

Some Other "Yankee" Tools

Spiral Screw-drivers
Plain Screw-drivers
Automatic Push Drills

Automatic Feed Bench Drills
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Vises—Removable Base

Ratchet Breast and Hand Drills

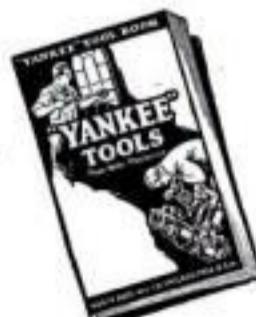
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"Yankee" on the tool you buy means the utmost in quality, efficiency and durability

Write for FREE "Yankee" Tool Book

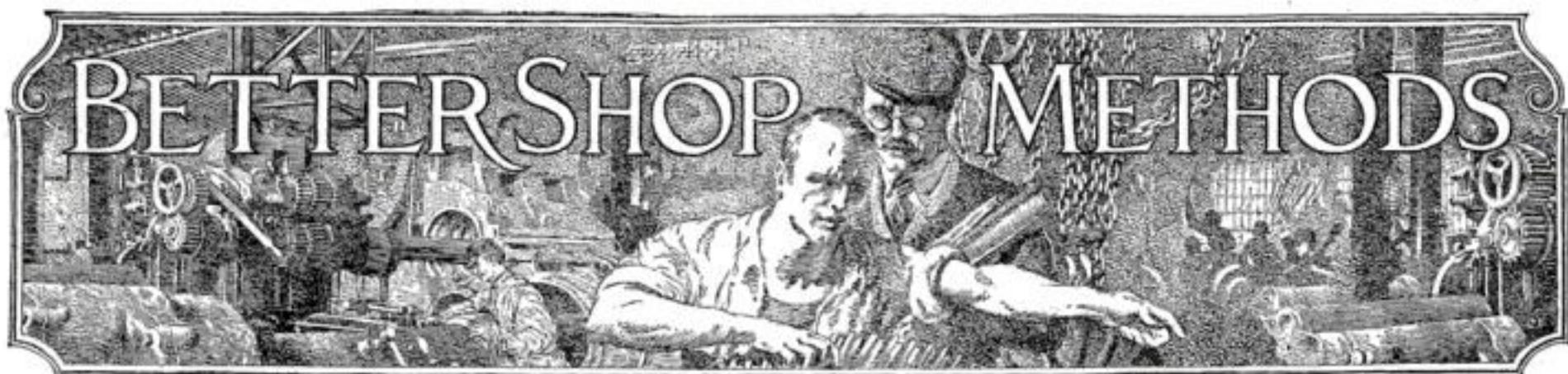
This interesting little book is for all lovers of fine Tools. It tells just what you want to know about all the famous "Yankee" Tools for making work easier and quicker.

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"YANKEE" TOOLS
make Better mechanics



Easy Ways to Do Recessing Jobs

Chuck Work Quickly in a Turret Lathe—Using a “Pull” Cut to Avoid Chattering—Hints on Facing

By ALBERT A. DOWD

“THESE castings have to be recessed,” said the machine shop foreman one morning to young Harvey Smith. “The original blueprint showed a straight hole, so we reamed them all to size, and now the engineering department gives me a blueprint like this (A in Fig. 1) and tells me to recess fifty of these pieces. You’ll have to hold them in a four-jaw independent chuck or set them on a short plug on a faceplate so the inside hole will run true. See what you can do to hustle the job out.”

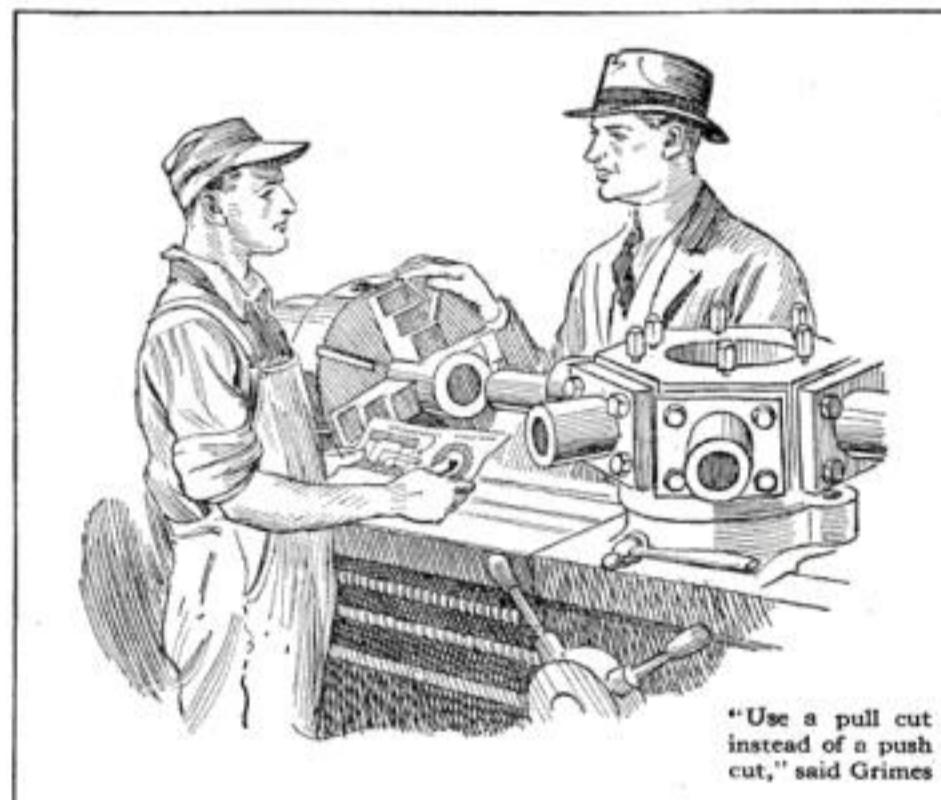
The foreman walked away and Harvey looked doubtfully at the blueprint. It called for a recess $\frac{1}{16}$ in. deep and $1\frac{3}{4}$ long, inside the previously reamed hole. Then he picked up one of the pieces, which were of cast iron, unfinished on the outside and faced only on one end. As he stood there thinking it over, Mr. Grimes, the efficiency engineer, came along.

“Anything of interest this morning?” he asked cheerfully.

“Not much,” the young machinist replied, “only the foreman just gave me the job of recessing these castings that have already been bored and reamed. I’ve got to get the recess somewhere near concentric with the other hole.”

“HOW are you going to do that?” inquired Grimes.

“Oh, Tom said to put a plug in a faceplate or hold them in a four-jaw chuck. He didn’t seem to care how I do the job. I think I will use the four-jaw chuck on the lathe here; put a



“Use a pull cut instead of a push cut,” said Grimes

“I would have to turn up a plug of the right size,” he continued, “and fit it to a sixteen-inch faceplate and then rig up some clamps to hold the work if I do it the other way, and it would take me two or three hours to get started.”

“Why don’t you do the job on that idle turret lathe over there?” suggested Grimes. “There is a four-jaw chuck already on it and I can tell you a faster way to do the work than either of those you have mentioned.”

THE engineer made a quick explanatory sketch (Fig. 2).

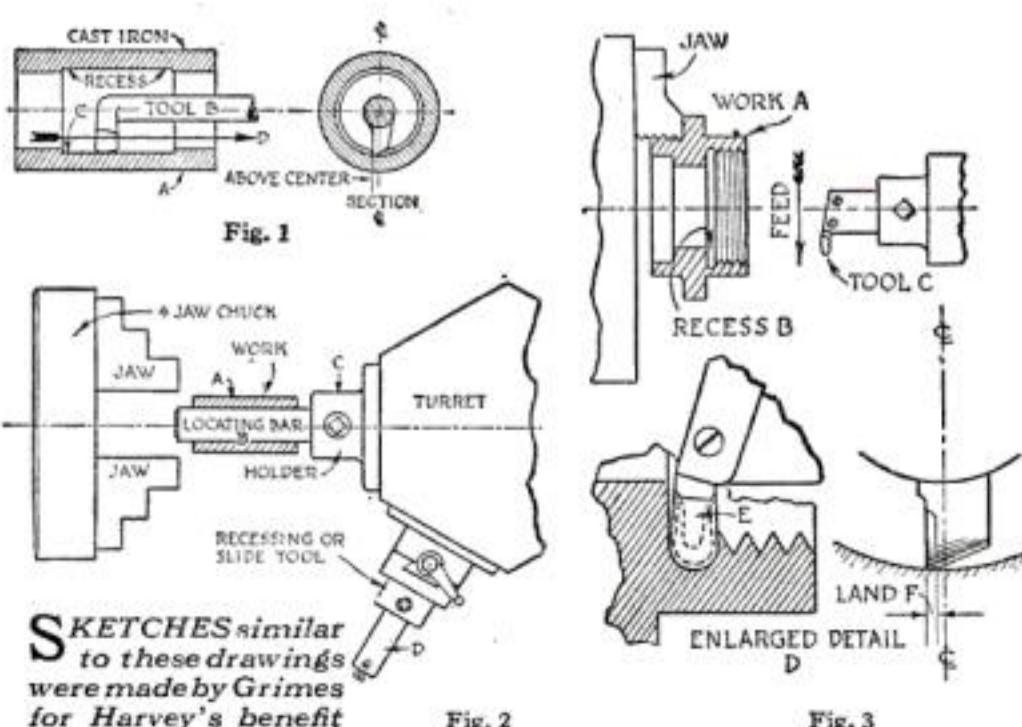
“See—just get a bar B, one and a half inches in diameter, and put it in holder C on the turret. Slip your casting A on to the bar and move the turret up until the work is up against the face of the chuck. Bring up your chuck jaws independently to grip the work and then pull back the turret out of the way.

You can easily mount a recessing tool at D and then go right ahead and machine the recess.”

“That’s a great scheme, Mr. Grimes,” exclaimed Harvey enthusiastically.

“Yes, and you can apply the same idea to other jobs now and then when you have an opportunity.”

“What about recessing operations?” asked Harvey. “Is there anything particular about the way the (Continued on page 100)



SKETCHES similar to these drawings were made by Grimes for Harvey’s benefit

Fig. 2

Fig. 3

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, pages 98 to 103.



"As the twig is bent"

If you've "been through the mill," you know what it means to a young fellow to start with the right tools. There isn't anything that'll help him more than a set of fine precision tools—Starrett's. Give him a Starrett Apprentice Set, No. 900.

If you're just beginning, here are the tools you need. It's a kit that you'll be proud to show any man, because they're all Starrett's, the tools that two generations of American craftsmen have accepted as the standard for quality and accuracy.

Starrett Apprentice Set No. 900 in a handsome folding leather case contains a 6 inch Combination Square complete, Center Punch, 6 inch Flexible Steel Rule, Center Gage, 4 inch Caliper, 4 inch Outside and 4 inch Inside Calipers with solid nuts, and 4 inch Dividers with solid nuts.

This Set and the Starrett Book for Machinists' Apprentices, Volume I of the famous Starrett Books, gives a fellow a flying start. Ask your dealer. And write us for a free copy of the 352-page Starrett Catalog No. 23 "W."

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562

Use Starrett Tools

Love Sends Convert to Pipe-smoking on Tobacco Hunt

Of course a young man in love will do anything to win favor in the eyes of his lady fair. And pipe-smoking seems to be one of the credentials that admit young male America into the graces of the fair sex.

But while smoking a pipe seems to solve the feminine problem, finding the right tobacco evidently is the male problem.

Probably that is what prompts such letters as this:

New York, N. Y.,
June 30, 1926

Larus & Bro. Co.
Richmond, Va.
Gentlemen:

I started smoking on cigarettes, but after meeting a young lady for whom men who smoked pipes had a greater charm, I promptly switched to one.

Then my agony began. I tried one brand of tobacco after another, always working on the theory that the more you paid for tobacco, the better it would be.

Then came the day I tried Edgeworth. It was at a ball game. I had run short of the certain brand I was smoking, and a casual acquaintance offered me a pipeful.

Imagine my delight when after the first few puffs, I did not feel the old familiar bite. I puffed on, inhaling the delightful aroma, and oh, boy! it was sweet right down to the bottom.

Nothing has separated me from my pipe, or my pipe from Edgeworth since then.

Yours very truly,
(signed) David Freedman, Jr.



Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Co., 10-P S. 21st St., Richmond, Va.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

[On your radio—tune in on WRVA, Richmond, Va. —the Edgeworth Station. Wave length 256 meters.]

New Uses for Plastic Paints

(Continued from page 69)

plaque (the rectangle with the lion on it; you can see it if you look closely) were smoothed down with the triangle and the whole was allowed to dry.

The next step was the application of the lion in the plaque and the fleur-de-lis in the two top cornerstones and out near the edges of the fireplace on a line with the plaque. These were made with uncolored plastic paint applied through stencils bought at the paint store. Then the joints were scored to produce the effect of stones with a common file bent at right angles to the tang or handle end. A yardstick and ruler were used to keep the scoring straight.

Next day the whole was sandpapered lightly with No. 1½ sandpaper to remove rough edges. A mix of a half pound each of rottenstone and size was made and applied with a Dutch calcimine brush. As the mix was applied with the right hand, it was wiped off with a soft cloth held in the left. Thus it stayed in the depressions and joints but was wiped off the high spots, and gave the whole the rich finish of old stones. This completed the job, all but coloring the lion in the plaque which was done some days later, with raw umber (artists' oil color), wiped partly off.

Now to return to the decoration of the other three rooms and the hallway:

The furniture in the bedroom that Eleanor and I share was given to us by Eleanor's mother, who had it as a wedding gift from her mother. So it is quite old. The design of all the pieces is heavy and substantial, more English in character than anything else, so we decided on a rough texture adapted from those found in

English cottages and a shade of about beach sand for the color. Of course, we first made the usual test panel on wallboard.

In this bedroom the walls were covered with wall paper, so we had before us the same job that had confronted us in the dining room. We removed all the old paper, washed the entire surface down with a solution of sal soda and hot water and then filled such cracks as there were with the cement that is used in the application of plaster wallboard.

Yellow ochre was the color mixed, first with water in a separate pan, and then with the plastic paint. The mix was brushed on to the wall in random sweeps. The English texture was produced with a

4-in. semiflexible putty knife. This was drawn over the wet paint in such a manner that welts appeared on either side of the knife, the extent of each sweep being about an eighth circle.

The material for the ceiling was mixed about two shades lighter than that for the walls, for a ceiling of the same shade would have appeared darker than the walls in the finished job. The ceiling texture simply was a brush texture—the paint was brushed on and left as was.

JUNIOR'S room was next. It originally had been decorated with calcimine. For a sturdy up-and-about youngster, Junior has a lot of consideration for walls. They were in virtually perfect condition, and all we had to do to prepare the surface for plastic paint was to wash the calcimine off and let the walls dry thoroughly. We felt that Junior would most appreciate a gay and cheerful color, so we decided on salmon. And we also felt that a novelty texture would interest the young man most, so we chose a finger scroll, which is developed with the tips of the fingers.

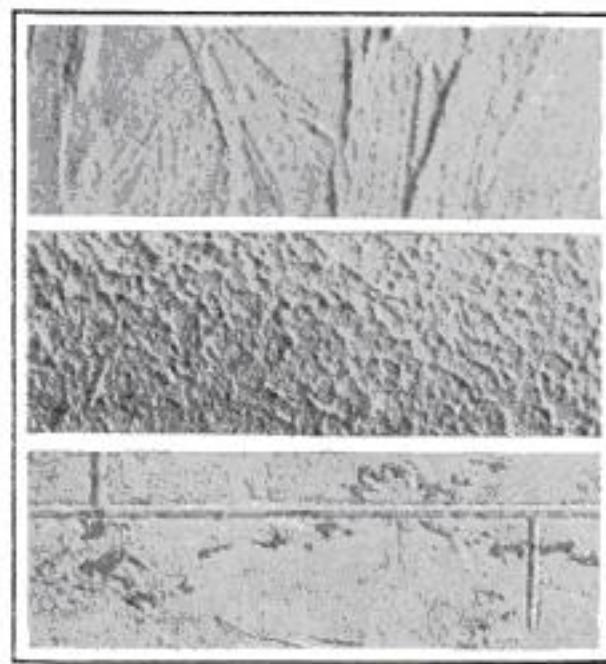
To color our plastic paint we used burnt sienna and yellow ochre in equal proportions. The paint then was brushed on the walls in the usual manner and the scroll texture was produced by drawing the tips of the fingers through the wet material in a wide circular motion. The ceiling was finished in a lighter shade and in the brush texture. After the walls had thoroughly dried, the few too-large welts that had turned up from under the tips of our fingers were sandpapered.

This left the guest room and entrance hallway. The guest room had wall paper on the wall. This was removed and the walls were treated as they had been in Eleanor's and my

(Continued on page 79)



Many striking effects may be obtained with the fingers, as in this simple scroll texture



Developing a travertine finish. Greenspar is blown on the paint after it is stippled

Plastic Paint Decorating

(Continued from page 78)

room. The texture selected was a brush finish and gray was the color chosen.

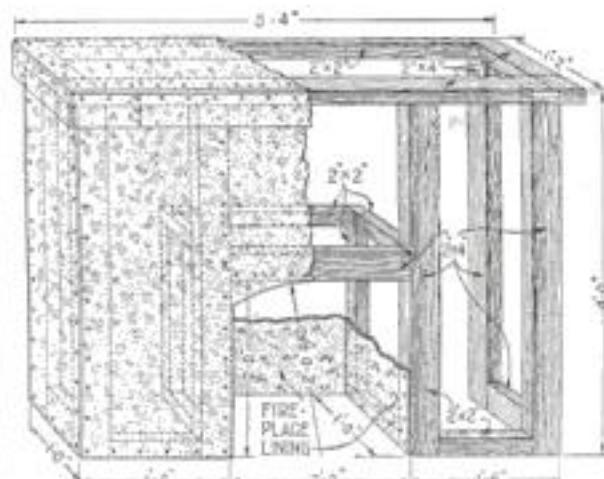
To get our gray color, dry Swedish black was mixed and added to the white plastic paint. I have since learned that dry lampblack can be used if it is first mixed with alcohol to cut the grease.

A plain brush texture was used on the walls and ceiling of this room.

Our entrance hallway was the next point of attack. We selected a finish of imitation travertine marble.

Now this effect really is simple to produce. Every step in its development is shown in one of the illustrations except the blowing in of the greenspar—a sand from Florida's beaches.

First, the plastic paint was tinted with raw sienna to approximately a deep cream. It then was applied to the walls and stippled with a stippling brush. Next,



TOP OF MANTEL EXTENDS 2" BEYOND BASE AND ENDS
How the fireplace framework is built and covered with wallboard ready for finishing

the greenspar was blown in simply by placing the powdered material on a sheet of paper, holding the paper about a foot from the wall and blowing the greenspar off the paper and on to the wall. A draftsman's triangle—the one used in making the fireplace—was drawn across the surface in such a way as to smooth down most of the stippling; the pits that remained completed the effect of true travertine stone. After the wall had thoroughly hardened, it was sandpapered with No. 1½ sandpaper and the stones were marked off as on the fireplace. A coat of size completed the job.

This effect was carried all the way up to the ceiling, which was finished in a brush texture and a cream color.

Thus, we completed the redecoration of our house. But we were by no means through with plastic paint.

The first idea I had was derived from an illustration in the picture section of our Sunday newspaper. The illustration was from some movie and showed a pirate on a sea beach, standing beside an old brass-bound chest, evidently a treasure chest. The chest was picturesque and I knew that one like it would be a good ornament for our living room or hall.

I needn't go into detail about the actual making of the box, but after it was made, it was necessary to treat all the joints with the same reinforcement used in building the fireplace.

The next thing (Continued on page 81)

"I Wonder How He Knows So Much!"

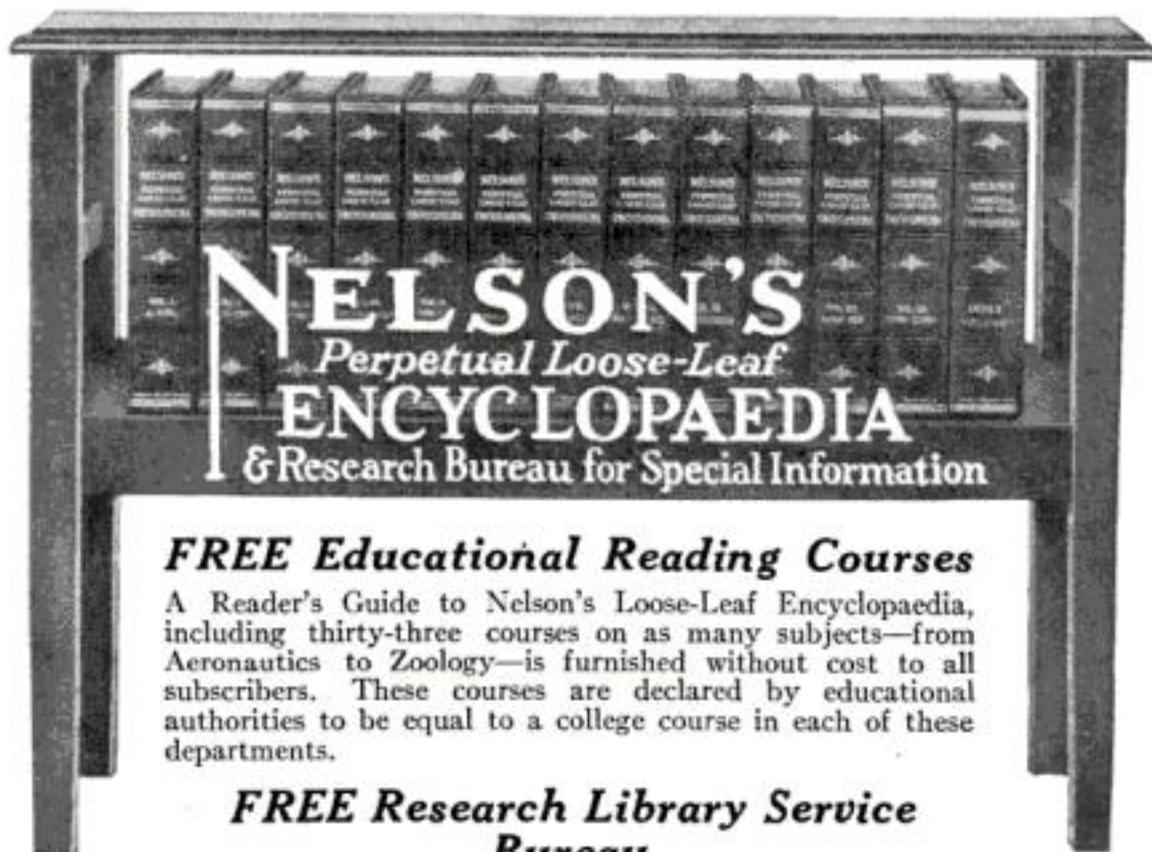
How many men do you know who surprise you by the wealth of their general knowledge and information on all sorts of subjects—history, biography, travel, politics, business, sports, and a thousand other things? If you were to inquire, you would find that these men make a habit of consulting an up-to-date Encyclopaedia. Here they have access to the knowledge of centuries—concise and plainly stated, easy to grasp and remember. Through the constant use of the Encyclopaedia they are familiar with all the things that people talk about.

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Name.....

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City..... State.....

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A Few Magic Minutes with Rogers brushing lacquer

You give a shabby chair a new coat of brilliant color. Thirty minutes later it is back in the living room *ready for use*

Like a fairy wand, your brush of Rogers Brushing Lacquer works magical transformations. Shabby things become works of art before your eyes.

Irksome preparatory work is gone. Experience is unnecessary. Merely dip the brush deep into the rich "Rogers" color. Apply it freely right over the old finish. "Rogers" covers perfectly. Flows together in a smooth, lustrous coating. And then it—

Dries while you wait!

Dries in thirty minutes. Dries in time for most urgent needs. Dries without laps or brush marks. Dries before dust can mar its satiny sheen. Dries before damage can come to it. Dries to a hard porcelain-like finish that wears and wears and WEARS; that does not print; that does not gather lint.

There are literally hundreds of uses for this amazing new home lacquer in every home, store and building. Adheres to unfinished wood, to metal, glass or any old surface. Anyone can apply it.

Dealers everywhere sell Rogers. Comes in cans ready for use, in 18 charming colors. Also black, white and clear.

Be sure to get the genuine Rogers in the "Oriental" can, the kind sold everywhere on a "Money-Back" Guaranty.

DETROIT WHITE LEAD WORKS, Detroit, Michigan
Makers of Highest Grade Paints, Varnishes, Colors, Lacquers



BRUSHING LACQUER

DRIES WHILE YOU WAIT

SHABBY?



Our "Money-Back" Guaranty

Try one can of Rogers Brushing Lacquer. If not more than satisfied, return what is left to your dealer. He is authorized to refund the entire purchase price

Also distributed and guaranteed by

ACME WHITE LEAD AND COLOR WORKS
DETROIT, MICHIGAN

LINCOLN PAINT AND COLOR COMPANY
LINCOLN, NEBRASKA

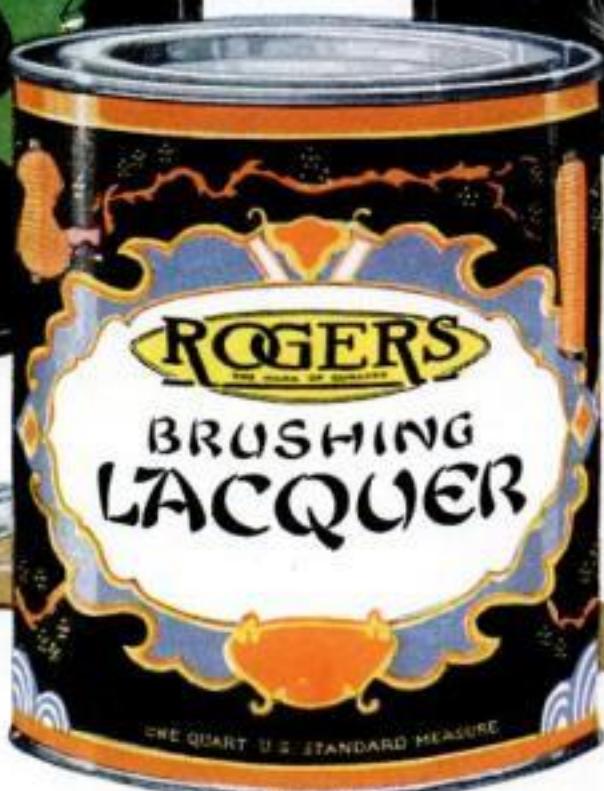
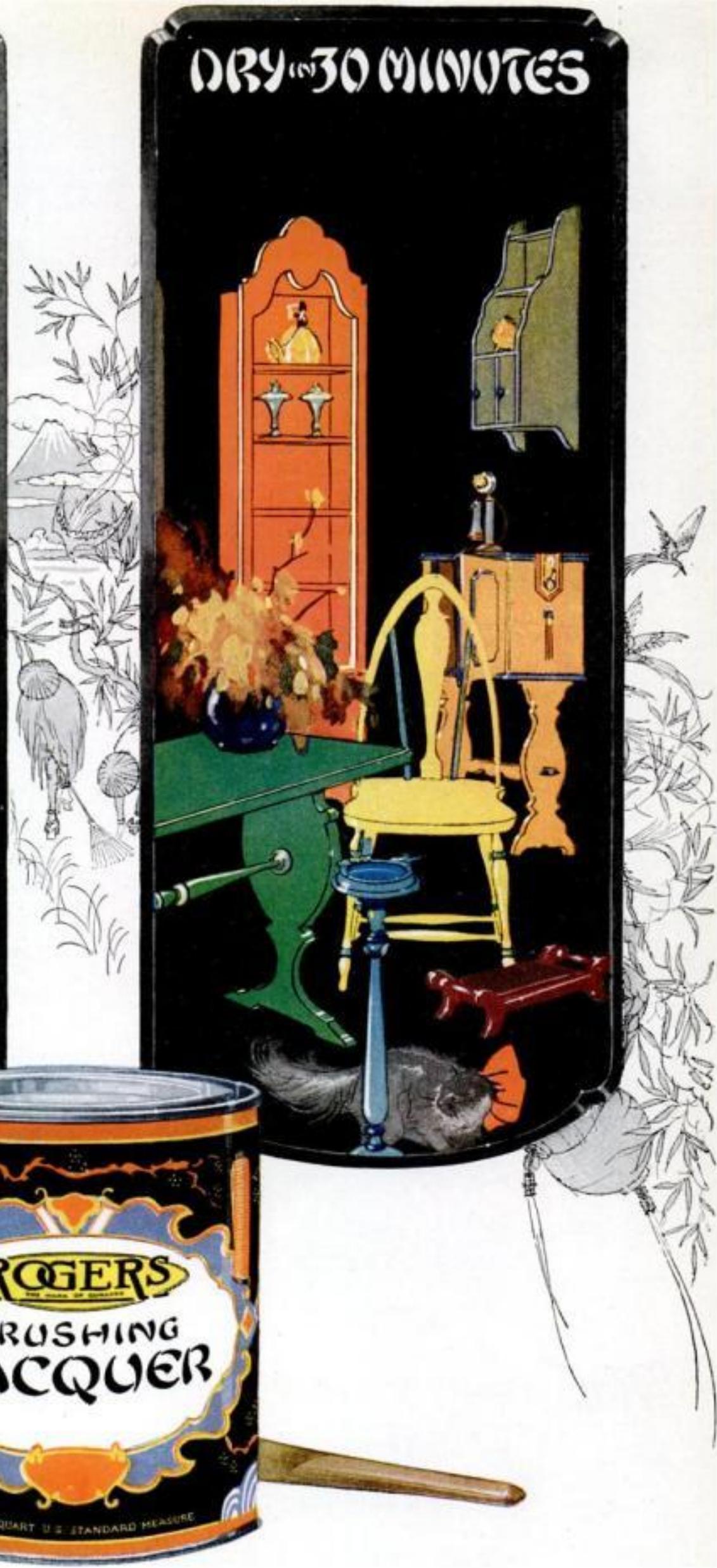
THE MARTIN-SEOUR COMPANY
CHICAGO, ILLINOIS

PENINSULAR PAINT AND VARNISH COMPANY
DETROIT, MICHIGAN

THE SHERWIN-WILLIAMS COMPANY
CLEVELAND, OHIO

LACQUER IT.

DRY IN 30 MINUTES



DRIES WHILE YOU WAIT



Mail

Now

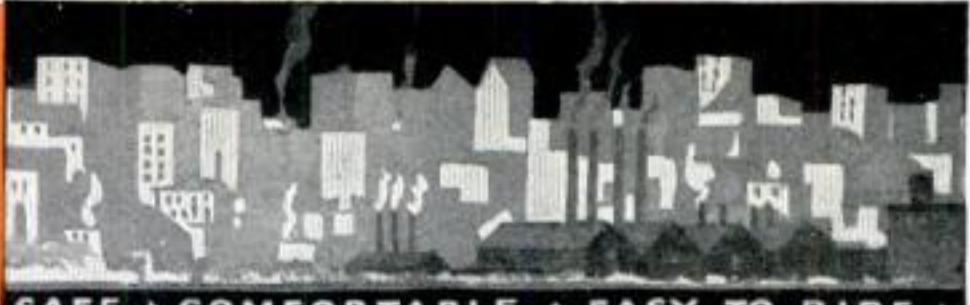
HARLEY-DAVIDSON MOTOR CO.,
Dept. P.S. Milwaukee, Wis.

Interested in Single

Interested in your Dealer Proposition. Is my territory open?

Name.....

Address.....



time! save money —have lots of fun, too

WITH a Harley-Davidson Single you can get to work and back, run errands, and ride around evenings in half the time you would spend on street cars or busses. And at far less cost! One cent per mile! On week ends and holidays you will get a world of pleasure out of the healthful outdoor sport of motorcycling. It adds a new joy to vacations, too.

The Single is easy to ride and control—safe. Parks in any 2x8 foot space—convenient. Travels 80 miles on a gallon—economical. Powerful Ricardo-head motor.

Easy to buy, too. Ask your Harley-Davidson dealer about his Pay-as-you-ride Plan. Price complete with 3-speed transmission and full electric equipment, f. o. b. Milwaukee . . . **235**

Mail the coupon for literature.

HARLEY-DAVIDSON MOTOR COMPANY
DEPT. P.S.
MILWAUKEE, WIS.

Big sales opportunities
in open territories.

The
HARLEY-DAVIDSON
[New-Type
Motorcycle.] **Single**

80 miles
per gallon

Plastic Paint Decorating

(Continued from page 79)

we did was to cover the whole box, except the bottom, with a thick coat of uncolored plastic paint. This was streaked and swirled with the brush to reproduce the grain and knots of old wood. After the paint had dried it was sandpapered lightly.

NEXT, stencils were cut in common stencil paper for the hinges, flanges and locks, and the plastic paint was applied through the stencils with a 4-in. semi-flexible putty knife to a thickness of about $\frac{1}{8}$ in. To give these imitation hinges, flanges and locks the appearance of hammered iron, we tapped them at random with the end of a pencil. This method was satisfactory enough, but I am now convinced that a better effect can be obtained with a stippling brush.

To make the corner bands, bottom bands and lid bands, we stuck adhesive tape on the box about 1 in. out from where the bands were to be. This gave us a "deadline" and kept our bands straight. The plastic paint then was applied with a putty knife to a thickness of $\frac{1}{8}$ in. and "hammered" with the end of a pencil. When the bands had dried they were lightly sandpapered and the adhesive tape was pulled off. Brass-headed tacks now were placed in a vise and dented with a hammer; then nailed into the "iron work."

Every pirate chest that is worth its salt has wormholes in it. So we put wormholes in ours—with an ice pick.

TO MAKE the front hinges, a pencil was broken in three parts, each part was dipped in plastic paint and then stuck on the box. When dry, the hinges were sandpapered lightly and scored to complete the hinge appearance.

Next, the whole box was coated with oak stain, which was wiped off lightly with a cloth to produce high lights and shadows. When this was dry the chest was given a coat of clear varnish and while the varnish was still "tacky" the box was dusted with rottenstone, the excess rottenstone being wiped off. The surface now resembled old wood; the next step was to finish the "iron work."

To the flanges and similar parts, a coat of aluminum paint was applied. When this had dried, lampblack was mixed with a small quantity of varnish and applied to the "iron work" and wiped off with a soft cloth. This left the black in the depressions.

The job was now finished but for the handles. Ours were hammered out of a piece of tin with a cold chisel and then treated with aluminum paint and lampblack and varnish, but I wouldn't recommend this method. Handles of many sorts, antique and otherwise, can be purchased, and they will serve as well as those we so laboriously made.

I could continue on and tell you how candlesticks were given an individual finish and texture with plastic paint; how vases and bowls and trays were made; how panels were stenciled and hung as pictures, but I might be robbing you of some of the fun that comes from working out such problems for yourself.



To "Show Me" Fellows

Let us show you that the claims men make for this unique shaving cream are true

—Accept, Please, Full 10-Day Tube to Try

GENTLEMEN:

When salesmen call on us, we give them a courteous hearing—then ask for samples.

And since it is a poor rule that doesn't work both ways, we sell Palmolive Shaving Cream on that basis. We think you are entitled to a testable sized sample before you try it.

Will you accept one—a full 10-day tube? We'll thank you for the opportunity.

60 years of soap study stand behind this creation. It embodies the expressed desire of 1000 men whose supreme wishes in a shaving cream were asked before we started it. Our whole experience as soap and skin

experts, as the makers of Palmolive Soap, is embodied.

5 new advantages

1. Multiplies itself in lather 250 times.
2. Softens the beard in one minute.
3. Maintains its creamy fullness for 10 minutes on the face.
4. Strong bubbles hold the hairs erect for cutting.
5. Fine after-effects due to palm and olive oil content.

Just send coupon

Your present method may suit you well. But still there may be a better one. This test may mean much to you in comfort. Send the coupon before you forget.

THE PALMOLIVE COMPANY (Del. Corp.), CHICAGO, ILL.

PALMOLIVE 35¢
Shaving Cream

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream. There are new delights here for every man who shaves. Please let us prove them to you. Clip coupon now.

Simply insert your name and address and mail to Dept. B-1303. The Palmolive Company (Del. Corp.), 3701 Iron Street, Chicago, Ill. Residents of Wisconsin should address The Palmolive Company (Wis. Corp.), Milwaukee, Wis.

10 SHAVES FREE
and a can of Palmolive After Shaving Talc

(Please print your name and address)



Strop your blades and put the saving away for a rainy day

Perhaps you don't realize how much you spend for blades in a year. Figure it out some day—the total will surprise you.

Stropping will save a big part of it, for stropping not only puts a much keener cutting edge on a blade but keeps it keen indefinitely.

Here are the cold facts from a Certified Public Accountant—

"I shave practically every day, therefore my Twinplex has stropped a blade over four thousand times. If I had used a new blade daily, as I had to before I bought the Twinplex, at 75 cents for 10 blades, I would have paid out at least \$300.00 for blades. But with the Twinplex, a blade always lasts at least a week, and some two and three. I have had fine, smooth shaves, better than the new blade without stropping for less than \$30."



But the saving is only half the story. If you've never used a NEW blade stropped, you've never had a really good shave. Take this opportunity to get one.

Stropped NEW Blade Free

Name your razor and we'll send you, free, a NEW blade stropped on a Twinplex. We would like to show you what real shaving is.

All dealers are authorized to sell you a Twinplex on 30 days trial. If after four weeks of marvelous shaving you are willing to forego the comfort and economy you have enjoyed, give up your Twinplex and get back your money. If you can't find the model you want, write us.

TWINPLEX SALES CO.
1757 Locust Street, Saint Louis
New York Montreal London Chicago

Twinplex
Stroppers

Tops Made of Spools and Clothespins

By F. CLARKE HUGHES

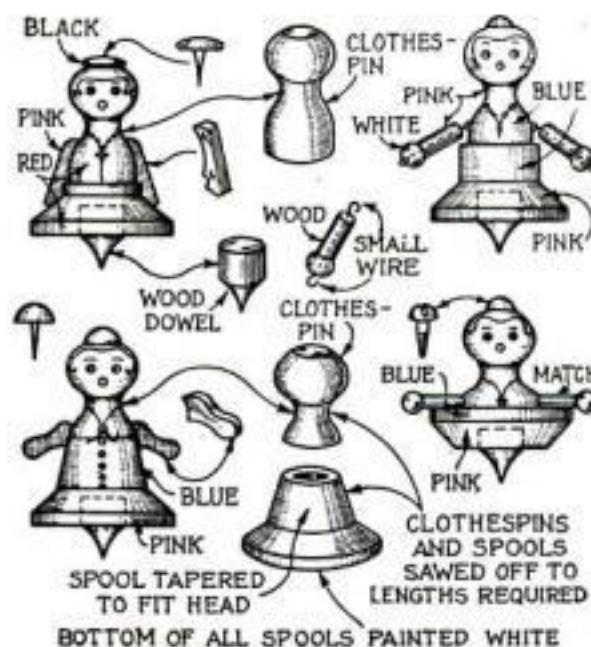
KNOB ends cut from ordinary clothespins and sections from thread spools are the materials necessary for making the tops illustrated. All four types of these quaint little "comiculls" may be made by combining the same materials in different ways. As many other styles may be constructed as there are spools and clothespins from which to make them. The ones that are low and broad spin the best.

The sections of clothespins and spools may be cut with either a knife or a saw. Be careful to have the ends square. When these are glued together, the arms, cap and spindle are added, as suggested in the sketches.

Only clear, bright oil colors, or fine,



Spinning one of the gaily painted tops



brilliant enamels should be used for finishing these little tops. Use pink or flesh tints for the face and arms, black for the hair and spindle, and any pastel shades for the costume. The under surface of the spool is painted white. A set of these tops will be much appreciated by any small child.

Next month—a clothes-pin fly.

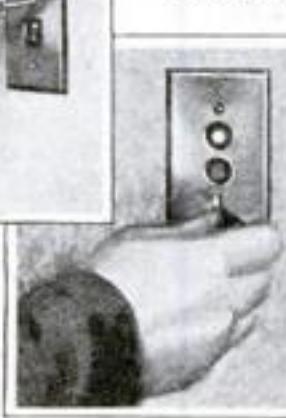
How to Replace a Flush Electric Switch

By GEORGE A. WILLOUGHBY

After the wires are connected to the new switch, as at the right, it is fastened in the switch box with the screws provided



Putting the cover plate on the new switch (above), which is of the modern tumbler type. The cover matches the woodwork of the room. It replaces the old, worn switch shown at the right.



MODERN types of electric switches and cover plates often will improve the appearance and convenience of a lighting installation out of all proportion to the moderate cost of the materials which must be purchased to make the change.

Whenever you have to replace an old flush switch, either because it is shabby or has become defective, the necessary steps are as follows:

First, remove the cover from the old switch by taking out the two screws. Second, take out the screws with which the wires are connected to the switch and remove the switch bodily from the outlet box. Third, remove the terminal screws from the new switch, slip them through the loops on the ends of the wires, and replace them in the switch. Fourth, put washers, which are furnished with the switch, on the screws, if necessary, to bring the surface of the switch flush with the plaster, as shown in the upper illustration. Then fasten the switch in the box and adjust it to a vertical position. Fifth, attach the new cover plate.

Open the main house switch before doing any of this work.

WINS 1st PRIZE

Cost

\$4⁹⁸**MAYFLOWER***The Ship that brought the Pilgrims to America*

Size: Height 25", Width 9", Length 27"

**SANTA MARIA***The Flag Ship of Columbus in the Discovery of America in 1492*

Size: Height 25", Width 11", Length 27"

THESE MODELS CAN BE ASSEMBLED IN A FEW HOURS

MRS. CLARRAH J. BIERBOWER of Philadelphia wins first prize in Science and Invention Model Contest. The parts for the ship model entered by Mrs. Bierbower are supplied by miniature ship models at a cost of \$4.98. The model entered was the same as the "Santa Maria" pictured above; no extra parts were added to those supplied by us.

This is the first time that the Grand Prize has ever been awarded to a woman. You can build a prize winner from parts supplied by miniature ship models.

We, the world's largest builders of ship models will help you build a prize winner by supplying all the parts cut to fit, and ready to assemble for either the "Santa Maria" or "Mayflower."

List of parts supplied for "Santa Maria." Space does not permit describing the parts for Mayflower but it is just as complete in every detail. Hull and keel, 3 pieces; rudder;

rudder support; 6 hause pipe rings; 6 cannons; 6 port shutters; 11 shields; front and poop deck sides; railings; upper deck with decorated stern; colored picture for stern; rigging channels; anchor; lamp and bracket; crow's nest; bow sprit and yard arm; 3 masts, fore, main and mizzen; spanker boom; jib yard arm; fore mast yard arm; main sail yard arm; top sail yard arm and lateen sail yard arm; wire for sails; brass name plate; rigging cord (light and heavy); brads; staples; glue; pulleys or blocks and falls; rear balcony; rear balcony railings; side balconies; side cabins; flags; ladders; 18 bumping strips; jib sail; fore sail; main sail; top sail and mizzen sail; stand, 3 pieces; over hull and parts are made of wood. This is not a cheap cardboard imitation. Shipping weight, 6 pounds. All Canadian and foreign orders must be accompanied by Money Order for \$4.98, plus a sufficient amount for Parcel Post charges.

**A Pleasant and Profitable Pastime
for Everyone**

**Thousands Being Sold Everywhere
at Astonishing High Prices**

Order Your Prize Winner Today

MINIATURE SHIP MODELS

3818-20-22-24 Baring Street, Philadelphia, Penna.

Please send me the completed parts, cut to fit, and ready to assemble for the Model _____

I will pay Postman \$4.98, plus postage (a few cents).

Please Print Name and Address Plainly to Avoid Delay

NAME _____

STREET OR R. F. D. _____

CITY _____ P.S. _____

STATE _____

MINIATURE SHIP MODELS
3818-20-22-24 BARING ST. - PHILADELPHIA, PENNA.



**"I
wouldn't
part
with
it"**

"That's how I feel 'bout the new Cheney Finishing Hammer. Haven't used it very long neither, but long enough to know it's a heck-uva fine hammer.

"Lookout th' slender hickory handle on this Cheney. Just what I've always wanted for finishin' work. It's light and easy to grasp and has a spring in it that makes it rebound from the nail in great style. 'N this high crown on the business end of th' Cheney—why I never find any of th' usual hammer marks on my finishin' work.

"The Cheney's a great little Finishing Hammer, all right, 'n I wouldn't swap it for a dozen other hammers!"



617

A Strong Joint for Boxes

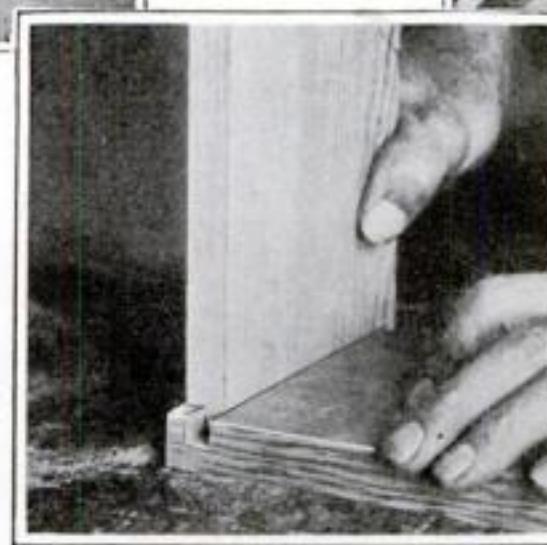
How to Lay Out and Make a Tongued Corner with Backsaw and Chisels

By EMANUEL E. ERICSON



1 Square the boards accurately, place together as shown (even on the outside), and make a knife mark. Here square a knife line across lower board

2 Gage middle line on end of second board. Run gage up about $\frac{3}{8}$ in. on each edge. Next square a knife line on the outside of the board $\frac{3}{8}$ in. from its end



4 Use a fine backsaw or panel saw for the cross-cuts on both boards. Hold the work firmly, as on a bench hook. Saw right to the middle of each knife line and on the proper side of it. Stop sawing when you reach the correct depth

5 While some may prefer to finish the tongue or tenon with a rip saw, I find it easier to use a fairly wide chisel. For the corresponding groove on the other board, a narrow chisel must be used. Be careful not to mar the edges of groove

6 The joint should go together with the pressure of the hands; if it is too tight, it is apt to burst. Glue the joint in any but rough work, and nail the parts together securely



How to Thumb-Slot Your Phone Book

By ARMSTRONG PERRY

ONE of the annoying experiences in life is to try to find a name in a telephone directory, when time is money or when the loss of a minute may mean the loss of a train. A man in England is reported as making \$5,000 a year by

The first step in indexing a telephone directory is to cut the slots with a gouge



going from office to office and house to house thumb-slitting telephone directories at two shillings each.

All the equipment needed to index your own telephone directory is a half-inch gouge (concave chisel), preferably with an inside bevel; a hammer or mallet; a rubber stamp alphabet with letters of a size to go within the semicircular slot made by the chisel, and a thin board.

The board is laid between the pages of the book where the A section ends and the B begins. The gouge is placed at the edge of the front cover near the top, and driven through the paper to the board. The board then is placed between the pages where the B's end and the C's begin. The gouge is placed below the first slot and a similar slot is cut. The process is repeated until the bottom of

the book is reached.

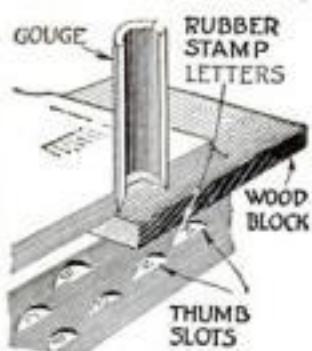
If the whole alphabet has not been covered, the slot for the next letter is cut at the top of the book, through just enough leaves to give room for the thumb. These second row of slots should be alternated with

the first row. This should be planned carefully at the start.

In directories containing the lists for several towns, the slots may be arranged according to towns.

When the slots are all cut, the rubber stamp letters can be placed.

City directories, dictionaries and other reference books may be indexed in the same way.



The method of cutting and lettering the slots

"He finished it between breakfast and luncheon, and the very next day we started off on our tour in what looked for all the world like a NEW car! I've always been a Kyanize fan—now I'm doubly so."

Mrs. Edna M.
Hinds,
Syracuse, N. Y.



Refinish It Yourself— with Kyanize Motor Car Enamel —the quick, easy, safe way

YES, sir, you *can* do it yourself! Any man, or woman for that matter, who can wield a brush can *make new* and *keep new* the finish of an old car. Kyanize Motor Car Enamel will do it. Mixed, ready for instant use, you flow it on with a good clean brush over the well-cleaned surface, give it a day to dry and proudly exhibit it as a *new car*.

Nothing to mix; nothing to add; levels itself and leaves no brush marks, ridges or laps. Dries hard in less than 24 hours. Wears and shines like polished metal. Water and weatherproof.

Use it anywhere about the home, too, on porch and garden furniture, toys, boats, canoes—and a hundred other places. For cushions, tops and upholstery use Kyanize Top and Seat Dressing—a worthy companion to Kyanize Motor Car Enamel.

BOSTON VARNISH CO.,
722 Everett Station, Boston, Mass., U. S. A.

\$1. Trial Offer. If your dealer cannot supply you, send us his name and ONE DOLLAR for a full pint can Kyanize Motor Car Enamel (state color desired) or Leather Top and Seat Dressing (state which), together with a good brush to apply. We'll also include a copy of our book, "How to Paint Your Automobile." Colors: Black, Red, Brewster Green, Coach Blue, and other colors.



Simply brush it on!

Kyanize

VARNISHES & ENAMELS for Floors-Furniture-Woodwork

STAR HANDY GUIDE for HACK SAW USERS

Material to be cut	★ HAND BLADES								
	SPECIAL FLEXIBLE			FLEXIBLE BLADES		ALL HARD			
Length	No. of Teeth	Order No.	Length	No. of Teeth	Order No.	Length	No. of Teeth	Order No.	
Large Stock	8"	14	8145F	8"	14	814F	8"	14	814
	9"	14	9145F	9"	14	914F	9"	14	914
	10"	14	10145F	10"	14	1014F	10"	14	1014
	12"	14	12145F	12"	14	1214F	12"	14	1214
Ordinary Work or General Use	8"	18	8185F	8"	18	818F	8"	18	818
	9"	18	9185F	9"	18	918F	9"	18	918
	10"	18	10185F	10"	18	1018F	10"	18	1018
	12"	18	12185F	12"	18	1218F	12"	18	1218
Pipe, Drill, Plates, etc.	8"	24	8245F	8"	24	824F	8"	24	824
	9"	24	9245F	9"	24	924F	9"	24	924
	10"	24	10245F	10"	24	1024F	10"	24	1024
	12"	24	12245F	12"	24	1224F	12"	24	1224
Thin Pipe Light Sheets, etc.	8"	32	8325F	8"	32	832F	8"	32	832
	9"	32	9325F	9"	32	932F	9"	32	932
	10"	32	10325F	10"	32	1032F	10"	32	1032
	12"	32	12325F	12"	32	1232F	12"	32	1232

	★ POWER BLADES							
	HEAVY—ALL HARD				LIGHT—ALL HARD			
Length	Gauge	No. of Teeth	Order No.	Length	Gauge	No. of Teeth	Order No.	
12"	18	10	1239	12"	21	14	1252	
12"	18	10	1219	12"	21	14	1242	
14"	18	10	1439	14"	21	14	1442	
14"	18	10	1419					
16"	18	10	1619					
17"	18	10	1719					
18"	18	10	1819					
21"	18	10	2119					
24"	18	10	2419					
12"	18	14	1239A					
14"	18	14	1439A					
14"	16	10	1415					
16"	16	10	1615					
17"	16	10	1715					
18"	16	10	1815					
21"	16	10	2115					
24"	16	10	2415					
14"	16	8	1419B					
14"	18	8	1415B					

* All Hand Blades are 23 gauge—except Special No. 1420 for Large Stock which is 22 gauge.

"For fast cutting I use Star Hack Saw Blades"

Says G. R. SALTER, Maplewood, N. J.

5 points of the Clemson Star

1. CLEMSON EXPERIENCE . . . 123 years of the combined experience of the Clemson Family.

2. CLEMSON STEEL . . . Special Tungsten Steel made to exact specifications and correct manufacturing processes.

3. CLEMSON TEETH . . . The correct angle and rounded gullet of the teeth give them the maximum cutting ability, strength and endurance.

4. CLEMSON SET . . . The teeth are set in a manner to maintain the proper clearance, to keep the cut free of chips.

5. CLEMSON TEMPER . . . The heat-treating methods used give STAR Blades an extraordinary degree of strength, toughness and uniformity.

Every STAR Blade is branded with a STAR

YOUR Star Hack Saw Blades are miles ahead of any blades I have ever used or seen and I surely do sound their praises at every opportunity. It is a treat to be able to saw a piece of conduit or cable without having a blade snap off. They clear the cutting channel and operate very smoothly—for fast cutting you can't beat Star Blades."

Different Blades are required for different types of machines. Be sure you are using the right type of blade for the work you are doing. Write Hack Saw Blade Headquarters for full information as to the blade you should use to get the greatest speed and efficiency in your production operations.

FREE:—Let us mail you our large hack saw chart to be placed on your wall for handy reference.

HEADQUARTERS for HACK SAW BLADES
Since 1883
CLEMSON BROTHERS, INC.
MIDDLETON, NEW YORK

STAR HACK SAW BLADES

 This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

A Built-in Bookcase for Your Bedroom

By EDWIN M. LOVE

FAVORITE books that find their way into one's own room for the pleasant privacy of bedtime reading may be kept accessible, yet neatly in order, by the use of the small built-in bookcase illustrated. The construction is very simple, and it can be installed merely by cutting out a rectangle of plaster between two studs (upright wooden wall supports). Thus no floor space is taken. The depth of 5½ in. affords enough room for the average novel or other relatively small book.

The materials needed are a board 1 by 6 in., by 8 ft., and another 1 by 3 in. by 8 ft., pine, surfaced four sides and sanded; 1 piece ½-in. quarter-round molding, 8 ft. long, and 4 pair of shelf hooks.

Smooth up and plane to a width of 5½ in. two pieces of the 1 by 6 in. pine, 2 ft. 8



Even in the smallest bedroom there is room for installing a neat little bookcase like this

in. long. Square a line across 1 in. from both ends of one piece, giving an exact distance apart of 2 ft. 6 in. Gage a line around the ends ¾ in. from the face, and saw out the rabbets for the upper and lower jambs (see the illustration on the following page). Use this piece as a pattern for the other side.

Gage light pencil lines 1 in. from each edge, and, centering on these, bore ¼-in. holes ½ in. deep every 2 in. along the length. These are for shelf hooks.

Make an upper and a lower jamb of 1 by 6 in. stock, planed and cut to 5½ by 12¾ in. The two shelves are like them, but 12 instead of 12¾ in. long.

For a back, cut a rectangle of ¾-in. 3-ply panel veneer 13½ in. by 2 ft. 7½ in. A sheet of heavy fiber wallboard may be used instead of the plywood and, of course, will cost less.

Assemble the sides and the end jambs by nailing through top and bottom jambs into the sides with sixpenny finishing nails. First clamp the sides against the ends of the top and bottom jambs to insure snug joints. (Continued on page 94)

GOODELL - PRATT

High-speed, High-power Bench Grinder—485. Handy for bench and household use. High Abrasive Wheel, $5 \times 1\frac{1}{2}$ ". Adjustable Work Rest. Finished in red and black enamel. $6\frac{1}{2}$ " high above bench \$10.00

Goodell-Pratt Electric Drill. Sizes from $\frac{1}{4}$ to $\frac{3}{4}$ ". Light and Heavy Duty, for 110 and 220 A. C. or D. C. Steady drilling doesn't overheat these Drills. Vital parts readily accessible. These drills retail from \$3.60 to \$9.95

Automatic Drill—185. Mr. Punch. Push, and the tool returns. Drill points carried in handle. Length 10". Beautifully polished and nickelized, including 8 drill points from 1.16 to 11.64" \$2.75

All-steel Mitre Box—1285. Cannot bend or break, or become inaccurate. Angles more acute than 45° are secured by side attachment. Gauge can be regulated to saw any desired depth. Equipped with 28 x 5" first quality Back Saw \$27.50

Bench Vise—161. Moderately priced. Cut steel feed screw and guide rods insure rigidity. Jaws machined after assembly, so they meet accurately. Steel parts polished, iron parts enameled. 2" jaws, opening 2". Weight 3½ lbs. \$2.60

**GOODELL - PRATT**

Ratchet Bit Brace—7010. 10" sweep. Steel clad head on roller bearings. Chuck sockets and shells of malleable iron; forged steel jaws. Square shank bits. Polished and nickelized \$3.75

Automatic Screwdriver—111. Reversible, for driving or drawing screws. Can be used ratchet or plain. Handle finished in mahogany. Length, extended, with blade 19". Including 3 tool steel blades \$3.10

Saw Vise—745. Jaws hold saw for their entire length, 10", are self-aligning and can be taken out by removing single screw. Ball and socket gives flexibility in filing positions. Clamps to any bench $\frac{1}{4}$ to $2\frac{1}{4}$ " thick. Stands $9\frac{1}{2}$ " above bench. Weighs 5 lbs. \$5.00

Two Speed Hand Drill—5½. Black enameled frame. Handle cap unscrews to hold drills. Takes round shank drills, 0 to $1\frac{1}{8}$ ". Steel parts nickelized. 14 $\frac{1}{2}$ " long. Without drills \$5.50

Floor Scraper—469. Mahogany finished hardwood handle, 11" long, and set at correct angle. Reversible 3 x $4\frac{1}{2}$ " blade of finest tool steel, hardened and tempered to hold good cutting edge. Wing adjusting nut and curved pressure plate. Weight 1½ pounds \$1.65



THE ten carpentry tools pictured here are single examples of the sizes in which each is made. The catalog also features all kinds of tools for machinists, and professional and amateur mechanics.

400 pages of fine tools *FREE*

Select your tools from this catalog—then buy them from your hardware dealer, mill supply or automotive supply dealer

THIS 400-page catalog is used by carpenters, mechanics, and machinists—who select from its pages the tools they need—and buy them through their local hardware or mill supply man.

You, too, will find this a pleasant and easy way to buy tools. A three-page index helps you find what you want—at once. Clear, easily understood descriptions and good pictures leave nothing for you to guess at.

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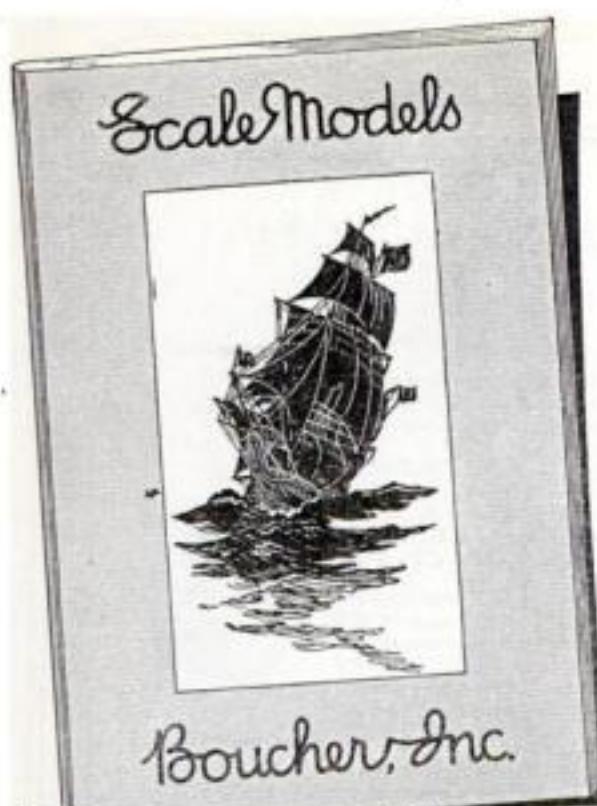


GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

MAKERS OF *Toolsmiths* MR. PUNCH

GOODELL-PRATT

1500 GOOD TOOLS



First Aid for Builders of Ship Models

Ancient and Modern

Plans—Scale Blueprints of historic and modern vessels, racing sail yachts and power boats

Lumber—Selected white pine for hulls, straight grained spruce for spars, three ply veneers for decks, mahogany, etc.

Tools—Specially designed—Chisel—Gouges and Planes to fit exactly modelmakers' needs

Hulls—Made to Scale of selected white pine in the rough partly finished or completely finished

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This booklet has many pages of information useful to modelmakers, model yachtsmen and others on sailing Model Yachts

Brief history of Steam Engines

Illustration of famous models made by the House of BOUCHER

Nautical terms in common use

Parts of a sailing vessel—spars, rigging, knots, hitches and splices commonly used on boats

Hints for painting and finishing Model Boats

Whatever type of ship—sail or steam—ancient or modern—you are building or planning to build, you will find the booklet "Scale Models" of tremendous help to you. Send 25c today for your copy. It will be sent to you by return mail.

Headquarters for Model Makers for 22 Years

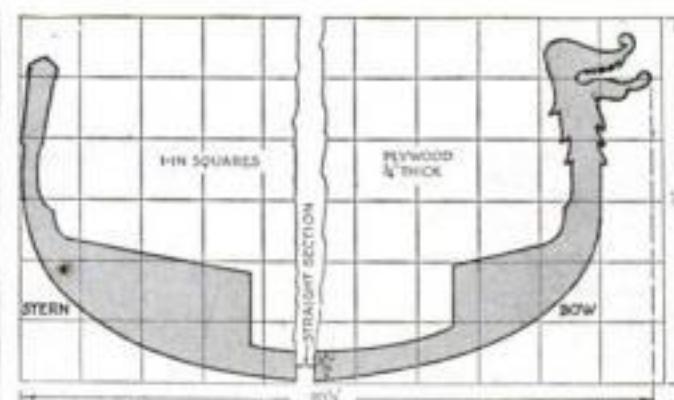
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415 Madison Ave., New York

Gentlemen:
Enclosed is 25c, for which please send me your booklet,
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Name.....
Address.....

A Ship Model All Can Build

(Continued from page 71)



To simplify the construction, the keel, stem and sternpost are in one piece of $\frac{1}{4}$ in. thick plywood

through the corner to these lines at several places. With a chisel chip out the waste wood to these saw cuts; then with a gouge or chisel cut away the rest until the blocks are about $\frac{1}{4}$ in. thick, with square ends, as shown. If the bow and stern decks are to be built up, these square ends also will be cut away, as mentioned before, and the whole of the hull pieces will be of the one thickness.

These two pieces now should be glued on to the centerpiece, being careful that they are evenly placed and that the bow end of them is toward the bow end of the centerpiece. Leave these three pieces clamped or wedged together for twenty-four hours to allow the glue to set thoroughly.

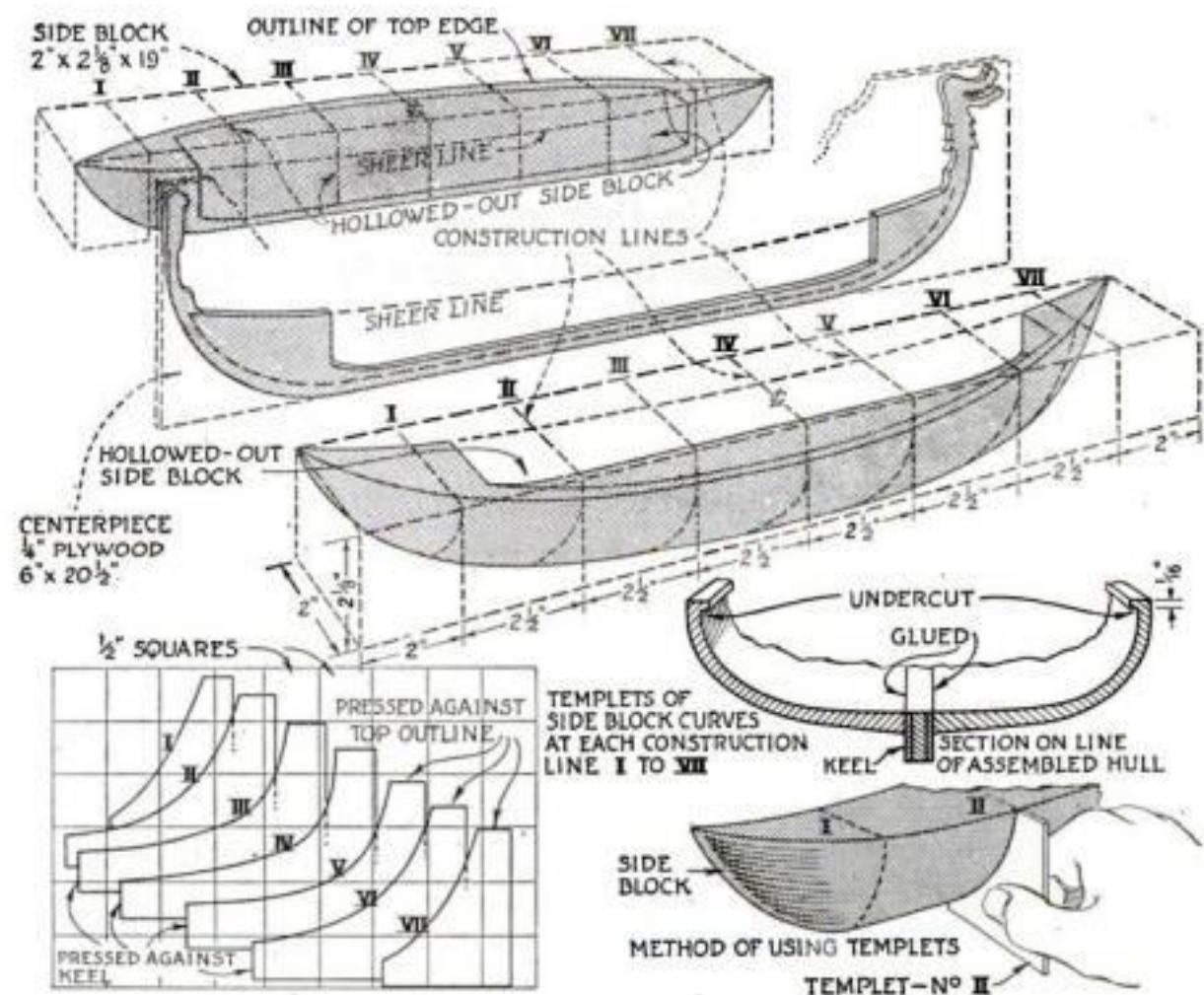
Hold the model up directly in line with the source of your light and see if you can detect any inequalities between one side and the other, or bumps or hollows. There should not be any but if there are, smooth them out, because a symmetrical

whole is more important than exact adherence to the lines given.

If you are able to make a neat job of it, the edges of the planks should be shown on the outside. The Gokstad ship had about thirteen planks to a side, but the Oseberg had only nine, and that will be as many as will look well on our model. Therefore, divide the side of the hull amidships into nine even spaces. Draw lines with a soft pencil along the hull so that the lines gradually draw together and curl up a bit to the ends; hold the model up to the light and look

along the lines to see that they flow evenly. With a sharp knife cut into the hull at these lines about $\frac{1}{2}$ in. deep. Then, with a small chisel held almost flat on the hull, cut up to these lines, thus forming right-angled grooves with their edges down, giving the appearance of planks, as with an ordinary clincher-built rowboat. How to do this is illustrated on page 71. This is not so difficult, but if you cannot do it neatly it is better not to do it at all.

Now proceed to gouge out the hull considerably thinner. Run another pencil line round the top edge a full $\frac{1}{8}$ in. from the edge and work gradually down from this to the bottom, where the inside of the hull should be level with the top of the centerpiece, here more properly called the keelson. Shave as thin as you safely can, but be very careful not to cut through. Holding the hull up to a bright light and watching for any transparency will give you (Continued on page 89)



Centerpiece, side blocks and templets for shaping the hull. These and all other details are given full size in POPULAR SCIENCE MONTHLY Blueprints Nos. 61 and 62, which are listed on page 92

Making a Big Bed Safe for Children's Use

By FRANK I. SOLAR

YOU may never have heard of a bed rail "saddle," but you have heard of the little folks falling out of bed. And bed rail saddles are intended to prevent just that. They are added to a big bed whenever it is to be used by small children and are stored away when not in use.

Any wood you have at hand will serve for the saddles as they are to be painted some bright color. Plane the surfaces, cut the ends square and hold the piece alongside the bed rail, if it is not perfectly



One or two bed rail "saddles" are added when children are to sleep in a large bed

straight, so that you can trace the pattern to be cut on the bottom edge. Also lay out the curves on upper edge and one end.

With a turning or coping saw cut carefully to the lines. Smooth the edges with a wood rasp or coarse sandpaper and finish with fine sandpaper. The paper should be wrapped over a round or oval stick, so it will fit the irregular curves.

The cleats are fastened with screws or stove bolts. If the latter are used, file the ends so the bed clothing will not catch on them. If your saddle is not as thick as the bed rail, fill out between the cleat and saddle with cardboard.

A Ship Model All Can Build

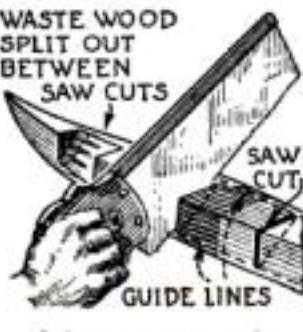
(Continued from page 88)

sufficient warning of dangerous thinness.

At about $\frac{1}{16}$ in. from the top edge there should be a sharp cut-under of about equal depth, and from there an even curve to the keelson. Sandpaper the ship reasonably smooth inside.

That completes the main part of the hull of our Lief's long serpent. It is, in fact, very similar to the ship in which another Lief, the son of Eric the Red, discovered America.

Next month we shall put on the gunwales and interior fittings. Already, however, our model is interesting and good to look at.



A few saw cuts make it easy to hollow out the two side blocks

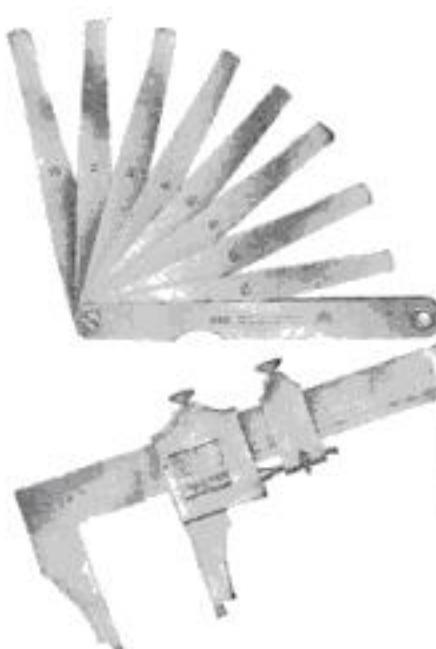
How Thick Is A Page Of POPULAR SCIENCE MONTHLY?



The thickness of a page of this magazine—.0027 of an inch—is several times as great as the variation frequently allowed in machine tool work.

For making measurements twice, four and frequently ten times as fine as this, mechanics the world over rely on Brown & Sharpe precision tools.

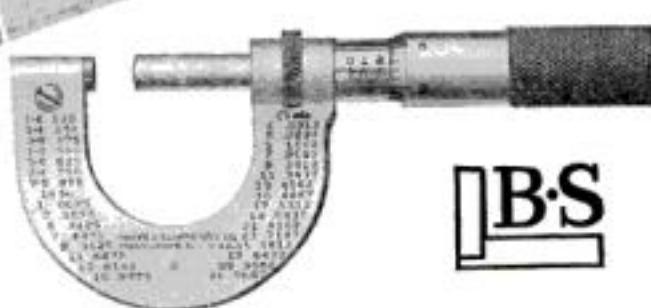
These tools are used in both commercial manufacturing and the finest of tool work. They are used every day in making fine measurements in mechanical industries where accuracy is a paramount point.



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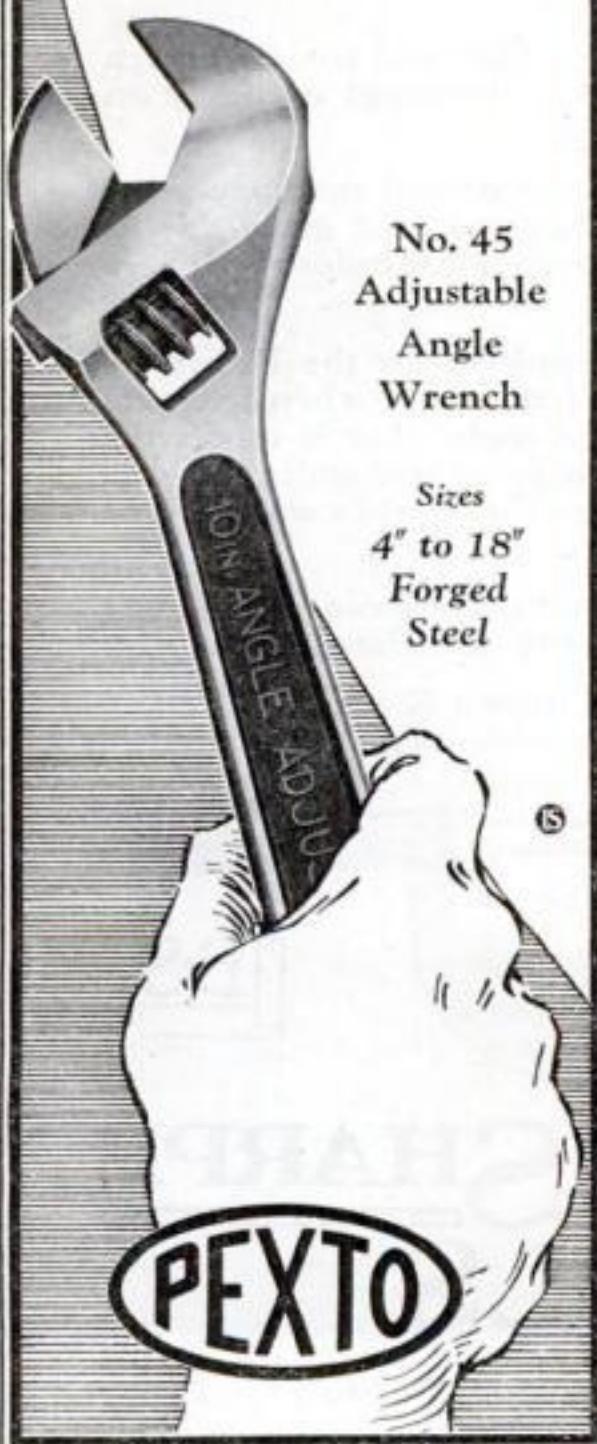
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The Peck, Stow & Wilcox Company
Southington, Conn., U. S. A.



You Can Build This Armchair

(Continued from page 72)



Five typical designs for cross-legged armchairs. The Spanish type (D) is especially popular at the present time. The carving often is most elaborate

permits a degree of flexibility. The broad leather seat and rather high back of leather adapt themselves to body pressure, so we have a very comfortable chair.

"In this sketch (G, page 91) we have a semifolding chair; it has a sort of rule joint for the center which permits the arms to be brought together and the chair to be folded so it may occupy a smaller space. The seat is of heavy leather, while the back is made from a piece of cotton belting or webbing covered with leather. The flexibility thus gained permits greater adaptation to the position of the body and as it has a wider seat and back than the others, it is a wonderfully comfortable chair."

"Why don't we see more of these chairs?" asked Val.

"WELL, there are various reasons. The very fact that they are not being purchased by the rank and file of furniture buyers means that few are manufactured, hence methods of mass production cannot be economically applied. Of course, that makes the price higher than for other chairs of more usual forms. The more elaborate and heavier chairs (C, D and E) are suitable for club and lodge rooms, anterooms and libraries, rather than for homes, where they seldom have the setting or vista to do them justice. Besides this, the legs must be sawed from a plank so the grain will give the greatest strength possible to each leg. This causes such

a waste of high grade lumber that the chair is not favored by designers and manufacturers of commercial furniture. Such a chair is a luxury—unless, of course, you make one yourself, and get a seventy-five-dollar chair for perhaps fifteen dollars or less in materials."

VAL had been examining carefully one of the dimensioned drawings (G) in the sketchbook. Now he said enthusiastically:

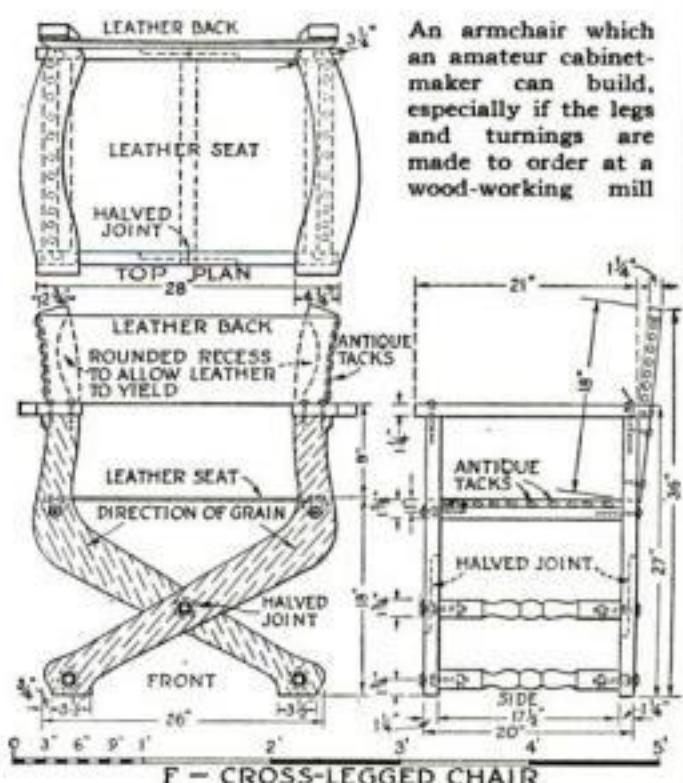
"I believe I will make one of these chairs this winter for my 'evenings-at-home' job. It will be fine in the hall beside the fireplace if finished in dark oak and upholstered with Spanish leather. How can I get just the right curve to the arms and legs from this sketch? I think I shall have them sawed at the mill, for I would find more hard work than pleasure if I tried to saw them from oak plank with a handsaw."

"You are right there," answered Jimmie, "and it is a simple matter to transfer and enlarge the curves. Make a sketch to a scale of, say, one and one half inches equals twelve inches and lay out squares like these—"

Jimmie took a pencil from his pocket and sketched rapidly, while Val watched him.

"These legs," explained Jimmie, "then may be enlarged to any size, and the curves accurately reproduced by drawing larger squares upon stiff cardboard. In this case they would be two and one half by two and one half inches. Draw the curves through them in the same relation as in the small sketch. Then cut the pasteboard to the lines and you have a pattern that may be used in marking the legs upon the plank preparatory to band sawing. The arm, and in fact any curved line may be

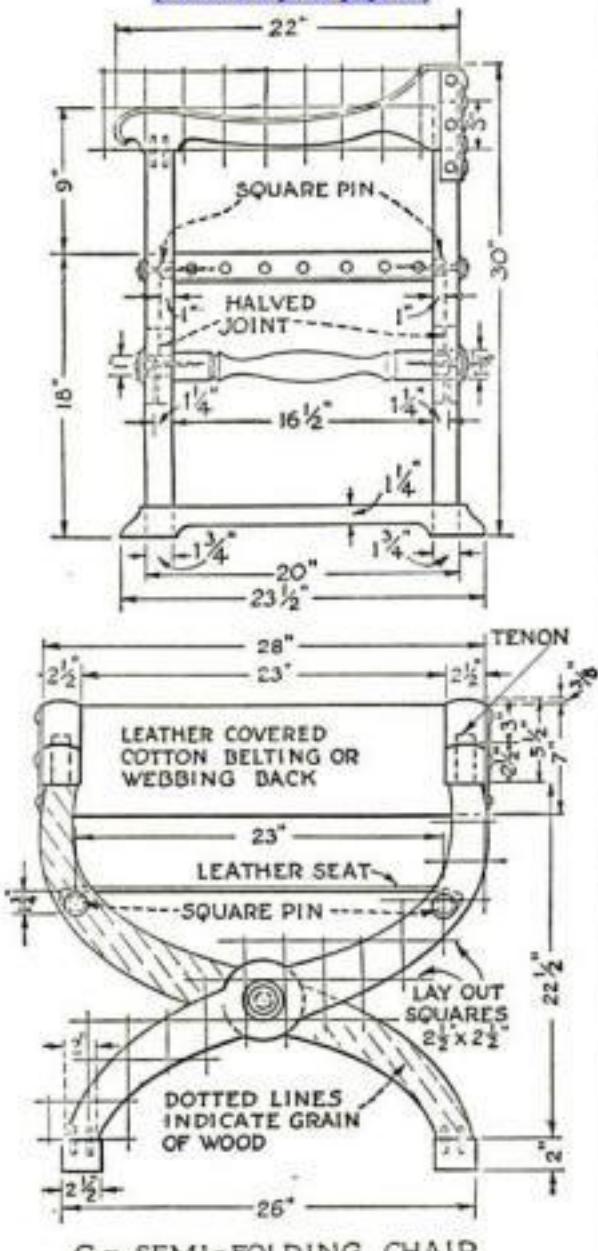
(Continued on page 91)



An armchair which an amateur cabinet-maker can build, especially if the legs and turnings are made to order at a wood-working mill

You Can Build This Chair

(Continued from page 90)



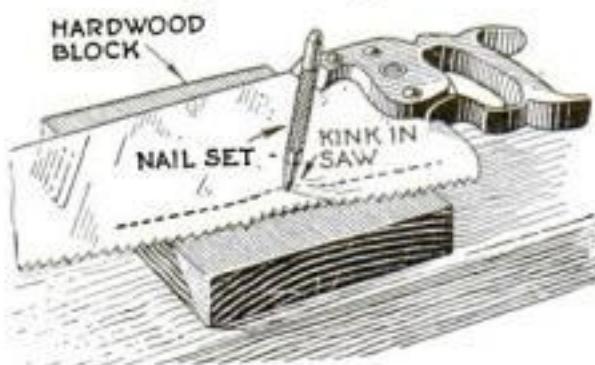
Working drawings of a fine type of cross-legged chair. Compare with D, page 90

enlarged in exactly the same manner."

"I understand perfectly," said Val. "I will work this out with a great deal of care and will have a lot of fun making the chair this winter. I think nothing else in the construction will give me much trouble. Anyway, I shall see you frequently and if I get in a tight place perhaps you will help me out."

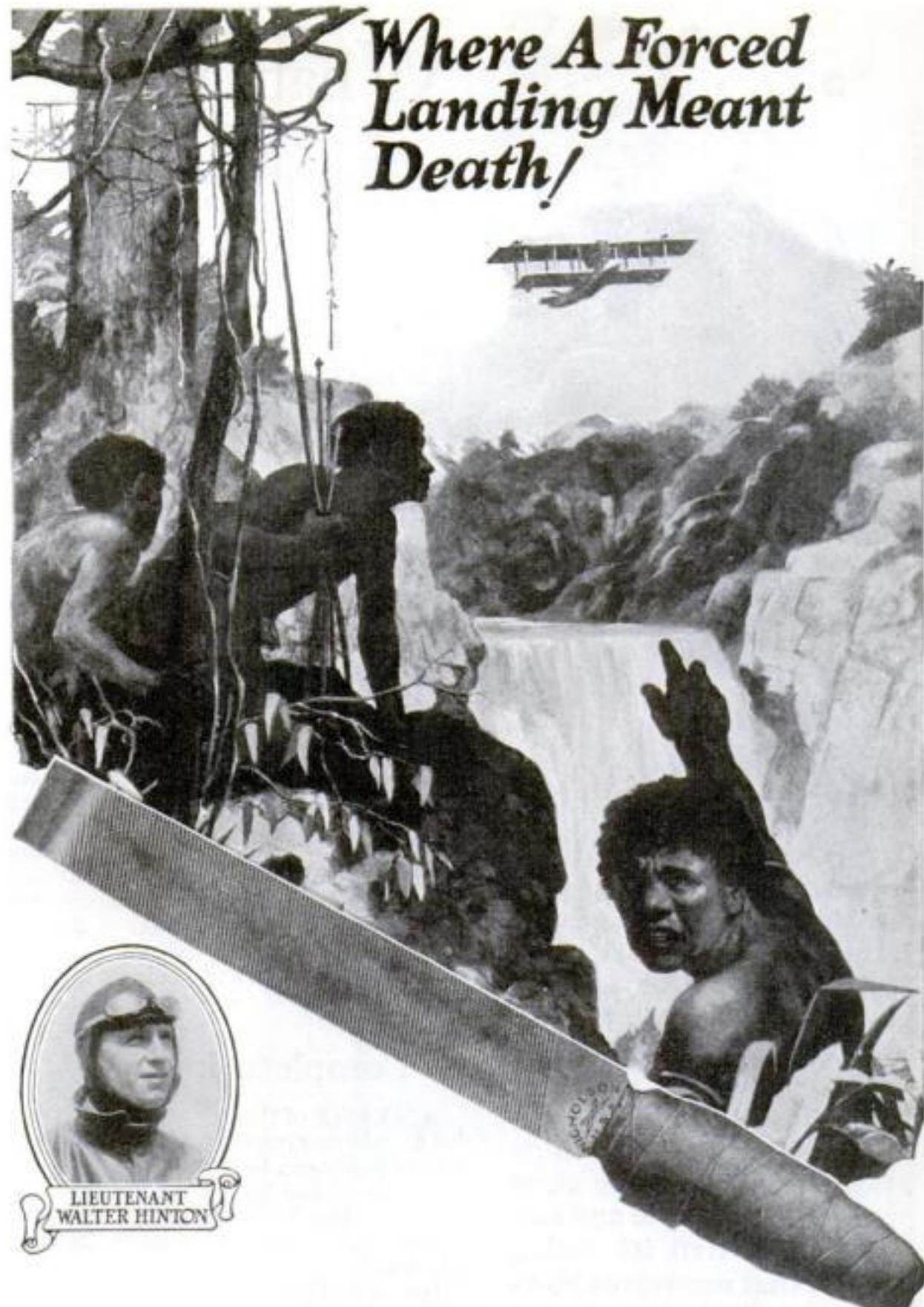
"Gladly," promised Jimmie.

Straightening a Saw



By the skilful use of nail set and hammer it is often possible to remove saw "kinks"

A FRIENDLY carpenter recently showed me how he removes a "kink" in a handsaw blade. He laid the blade flat on a hardwood block with the bulge of the kink upward. Then, with a nail set or drift and a hammer, he worked along the blade, as indicated by the dotted line, and hammered it flat. The weight of the blows was heaviest where the bend was highest.—F. H. T.



Where A Forced Landing Meant Death!

When Lieutenant Walter Hinton made his flight up the valley of the Amazon seeking the source of the Parima Watershed, he had to stay in the air. For below stretched an impenetrable forest where a landing meant certain death.

All tools but one had been stripped from the plane in order to save gasoline. That one was a NICHOLSON File. Lieutenant Hinton says:

"We cut our NICHOLSON File in half for the weight saved represented a pint of gasoline. But half a NICHOLSON File was far more useful to us than any other tool would have been. It could do a score of repair jobs in the air."

This striking proof of the usefulness of NICHOLSON Files is equalled only by their convincing record doing everyday jobs in industry and the home.

Lieutenant Hinton carried a 6" Flat Bastard File. Your hardware dealer can show you a duplicate — also the rest of the NICHOLSON line.

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Maydole
Hammers
The David Maydole Hammer Co., Norwich, N.Y.

What My Shop Taught Me

(Continued from page 74)

power, and this does away with the other grinder, as I can use the wheel attached to the lathe with much better results.

Perhaps the old grindstone, with its trough of water, as used by our forefathers, was the better way of grinding tools, but it is too slow for this swirling age, and modern emery and carbonized wheels make a faster job of it. But we must look out lest we spoil the tools by pressing them too hard and long against the wheel and overheating them.

A few of the things I have made are illustrated. The cedar chest was built entirely by hand from rough cedar purchased in the form of 1-in. planks.

Of the other things I have made—and enjoyed the making—may be mentioned three winter tops for three different cars, a Colonial mahogany desk, a Martha Washington sewing cabinet, a piano lamp, a radio set and cabinet, a corner



A desk of Mr. Strand's own design, which he constructed of mahogany throughout

cabinet for the breakfast room, an umbrella stand, medicine chest, all our kitchen furniture, including a porcelain top table, and one commercial job—a dental cabinet. This last piece was con-

structed of solid mahogany, white enameled inside with porcelain shelves, glass doors and a long beveled mirror running the full length. To make so elaborate a piece was no easy task.

I am looking forward eagerly to the time my little daughter is six years old, for then I plan to make a complete bedroom set for her with a bureau, bed,

chest of drawers, chairs, and a desk, all in miniature size, painted French gray and decorated in blue. I shall also see that she gets a doll's house.

So, in summing up, I may say that my little workshop means everything to me. It gives me just what I need—a rest in change—when I get home after a hard day's work.

Complete List of Home Workshop Blueprints

ANY ONE of the blueprints listed below can be obtained for 25 cents. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine, in which the project was described in detail, it can be had for 25 cents additional so long as copies are available. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.



POPULAR SCIENCE MONTHLY
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose..... cents:

No.	Title	Described in Issues of	Price
1.	Sewing Table	Feb., '22	25c
2.	Smoking Cabinet	Mar., '22	25c
3.	End Table	Apr., '22	25c
4.	Kitchen Cabinet	May, '22	25c
5.	Shaving Cabinet	June, '22	25c
6.	Arbor, Gate and Seats	July, '22	25c
7.	Porch Swing	Aug., '22	25c
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11.	Christmas Toys	Dec., '22	25c
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Name
(Please print name and address very clearly)

Street
City and State

Bird House Is Small Copy of Its Owner's Home

IF YOU enjoy model making, why not build a bird house that is a miniature of your own home? That is what we did. Our bird house, as the illustration shows,



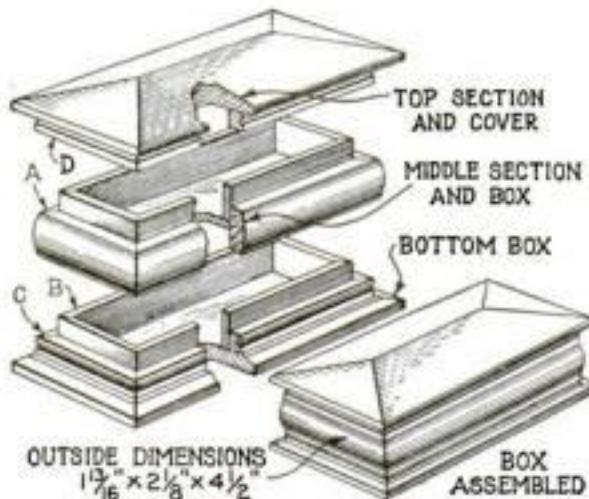
In every detail of its exterior, the bird house (at left) is a miniature copy of the house above

is an exact model of our own house. It has a door set in and carved exactly as in the big house and, of course, it is painted the same color. The miniature window boxes serve as perches.—GORDON H. SEARS.

Mystifying Stamp Box Has Secret Compartment

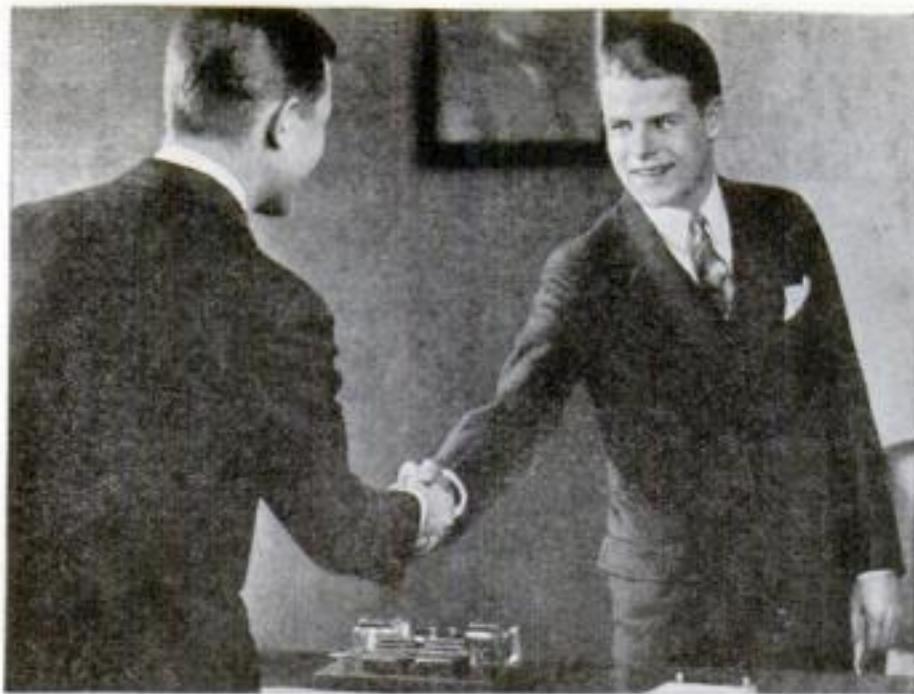
USUALLY one not in the secret will pick up the top of this box and find merely an assortment of pins, paper clips, rubber bands and pen points. The knowing one, however, will grasp the middle section and lift both it and the top, thus revealing the secret stamp compartment in the bottom box.

In making the box, cut out the top $\frac{1}{2}$ by $2\frac{1}{8}$ by $4\frac{1}{2}$ in. and shape it as shown, and make the bottom, which is only $\frac{3}{16}$ in.



How the box is constructed. The bottom compartment is the one used for concealing stamps

thick. Then miter and glue together the $\frac{1}{8}$ by $\frac{1}{2}$ in. strips which form the pin tray or middle section—it is $1\frac{1}{8}$ by $3\frac{1}{2}$ in. inside measurement—and glue the $\frac{1}{8}$ in. thick bottom in place. Around the outside of this tray glue the strip A, which is $\frac{3}{16}$ by $\frac{5}{8}$ in. Then glue strip B, $\frac{1}{8}$ by $\frac{1}{2}$ in., and strip C, $\frac{1}{4}$ by $\frac{3}{16}$ in. to the bottom. Glue strip D, which is similar to C, to the top. If cutting and assembling are done accurately, the box will close tightly, yet open easily.—C. A. K.



For that clean-cut look of success

try this invigorating massage after shaving

SUCCESSFUL men look the part. They are clean shaven, clean cut, and well groomed. They have that glowing look of health and vitality.

A muddy, half clean, blackhead-dotted skin can never be a partner of the successful man. Yet you can have the clean look of success. It takes no extra time. It can be acquired easily and pleasantly in your own home.

After you shave, use Pompeian Massage Cream. You usually use something aftershave—hot towel, lotion or cream—to remove the

dirt and clinging soap particles that become imbedded in the skin. Water, lotions, soaps—all reach the surface only. They do not remove imbedded dirt and secretions. Pompeian Massage Cream does.

Use this pleasant, gentle cream after shaving. See how your skin takes on the glow of life and action. See how imbedded dirt, even blackheads, rolls out under the mild but efficient urge of this quickly applied massage. You will like its restful, zestful "feel." Above all, you will like it for the feeling it gives you that—by gosh! you really are clean.



Make this convincing hand test free! Wash your hands thoroughly. Rub a little Pompeian Massage Cream into the back of your hand until the cream first disappears, then comes out again. Notice this—the cream goes in pink and comes out black! The black

is dirt that you could not remove by washing. You can make this simple but convincing test today. Get a jar of Pompeian Massage Cream in any drug store for sixty cents. If you prefer to make the test before you buy, merely mail the coupon below.

POMPEIAN MASSAGE CREAM *Increases Your Face Value*

FREE .. TO MEN ONLY

The Pompeian Company, Dept. 31, Cleveland, Ohio. Please send me free, the sample tube of Pompeian Massage Cream, with enough cream to make the hand test, and to give me several massages.

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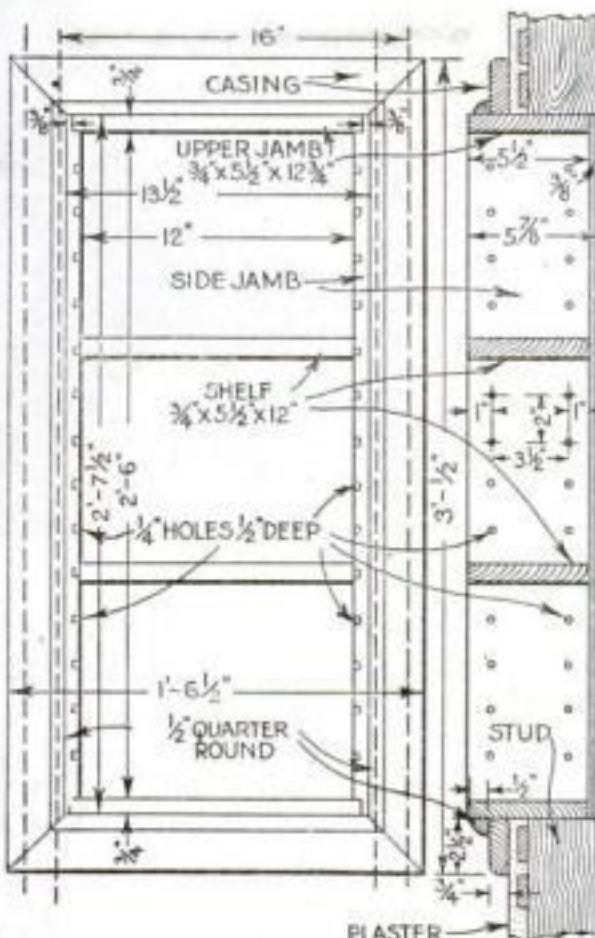
No matter whether you saw wood, metal, stone, bone or any other material—there's an ATKINS Saw ready to give better service. Ask or write for our free folder, "Saws In The Home."

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Leading Manufacturers of Highest Grade Saws for Every Use; Saw Tools, Saw Specialties, Plastering Tools, Machine Knives, Grinding Wheels and Files.

428 South Illinois St., INDIANAPOLIS, U. S. A.

A Built-in Bookcase

(Continued from page 80)



Front view of the case and a section through it showing how it fits between the wall studs

Then nail on the back, using shingle nails or fourpenny finishing nails. Saw off the projecting ends of the side jambs.

The case is now ready to install. Choose the location, and find the studs by tapping the plaster gently with a hammer, or by tracing up from the nails in the baseboard. If practical, it is well to have the inside face of the upper jamb level with the window head jambs.

Cut out the plaster between the studs with a top and bottom clearance of $\frac{1}{2}$ in. beyond the outside dimensions of the case. Use a cold chisel for the plaster and cut out the laths with a compass saw. Carefully chip off the "keys" of plaster inside the laths on the other side of the partition, and slip the case into place.

PLUMB accurately, wedging the sides with shingle points or other thin wood, and drive eightpenny nails through the side jambs into the studs.

Cover the rough edges of the plaster with a piece of 1 by 3 in. pine mitered around the box. Round off the outer edges before fitting. Since a $\frac{1}{2}$ -in. quarter round is applied after this casing as shown above, the joints between the casing and the box will be hidden and need not be accurately made, although the miters at the corners should be well fitted. Finally, round off the corners of the box to a radius of $\frac{1}{4}$ in.

Stain and varnish, or enamel or lacquer the bookcase to match the trim of the room.

NOVELTY effects in painting furniture can be obtained by stippling or mottling one color lightly on another, as buff or flesh color over a solid ground of gray. The first color must be thoroughly dry before the second is applied.

TRIMO

For Every Tool Chest or Bench



TRIMO Pipe Wrench

Distinguished in its leadership by special features that appeal to every man who appreciates good tools.

INSERT JAWS—Replaceable when worn with hard service at a fraction of the cost of a new wrench.

NUT GUARDS—Keeps the TRIMO adjusted perfectly in close quarters or when laid down.

TEETH THAT GRIP—But will not lock, but they can be released readily.

PRESSED STEEL FRAME—Will not break — therefore, TRIMO is stronger and safer than most wrenches.

Eight Steel Handle sizes—6 to 48". Four Wood Handle sizes—6", 8", 10" and 14".

TRIMO Monkey Wrench

Is made mechanically correct. The leverage increases in proportion to the increased size of the nut or object to which it is applied. The drop forged movable jaws extend outward instead of towards the handle to adjust.

Seven standard sizes—6 to 21 inches, inclusive.

**TRIMONT
MANUFACTURING CO.**
Roxbury (Boston) Mass.

America's Leading Wrench Makers For Nearly Forty Years

A Quick and Simple Way to Construct Window Screens

By A. J. PHELPS

WHEN making window screens, I follow a method that is the height of simplicity. It allows no chance for errors in measurement and, therefore, the screens are bound to go in place without any fitting and planing.

The two side pieces or stiles, which are $\frac{3}{4}$ by $1\frac{1}{2}$ in. stock, are cut to suit the window frame, and the bottom ends are beveled to fit the slant of the sill. Then these parts are laid flat on the sill and the center and top rails are marked for length; that is, the distance across the window less the combined width of the side pieces. The bottom rail is the same length, but is $2\frac{1}{2}$ in. wide. It also is beveled along one edge to suit the sill.

The stiles then are marked for the center rail at the height of the check



The strip of wood lying on the sill is a cross rail which is being marked for length

(meeting) rails of the window and the parts are nailed together.

Window screening is obtained of a width to lap over the frame $\frac{1}{2}$ in. on each side for tacking. A piece 1 in. longer than the opening is cut off. The way I do this is to slit about 2 in. of one edge, grasp the slit with one hand and then draw a knife between the weave.

In tacking the wire, I first fasten one side and end. A piece of $\frac{3}{4}$ in. thick wood is then placed $\frac{1}{2}$ in. away from the remaining stile on the under side of the screen. The fingers are placed on the screen over this strip and the thumb is pressed on the edge of the stile. This gives all the tension needed while tacking the remaining side and end of the wire.

A $\frac{1}{2}$ -in. screen bead is cut into pieces $1\frac{1}{2}$ in. longer and wider than the opening and nailed on, except toward the corners, which are left loose. A miter is sawed at each corner through both pieces of the bead, and the nailing is completed. A bead is bradded to the center rail and then the screen is ready for hardware.

This makes a light screen, but my experience has been that it is strong enough.

SpeedWay Shop

10 days free trial

8 POWERFUL MOTOR-DRIVEN TOOLS

Make things at home!

Think of it! The Super-SpeedWay Shop shown above gives you a complete wood-turning lathe, bench saw, a scroll or jig saw. All the necessary accessories for both portable and stationary power drilling, buffing, grinding, and cleaning.

The Super-SpeedWay Shop attaches to any light socket and will convert your workbench into a complete tool and machine shop, right in your home.

EASY TO MAKE THINGS AT HOME WITH THE SPEEDWAY SHOP

We are offering you this Super-SpeedWay Shop and tools on a ten-day free trial plan right in your own home. Test it—experiment with it. Use it as if it were your own. We know you will find it the handiest, fastest metal and woodworking outfit you have ever laid eyes on. Attach to any light socket, snap on the switch and zingo! The job is under way!

Can Make Money with SpeedWay Shop

You can make almost anything—attractive pieces of furniture, toys, home and garden improvements, radio cabinets, and consoles, brie-a-brac, bookshelves, countless other useful articles for your own use—or to sell! Moreover, you can do buffing, polishing, grinding, and drilling, either at the bench or wherever there is a handy lamp socket. There is a thrill of joy and pride in workmanship when you perform with the Super-SpeedWay Shop and tools.

\$10.00 DOWN—Balance Easy Payments

We make it easy for you to own one of these complete Super-SpeedWay electrically driven Shops. All you have to do is to give us a small down payment of \$10.00 as evidence of good faith and we will ship you one of these Shops—immediately! You pay for the balance as you use it—in small easy monthly payments which you'll never miss!

PORTABLE TOOLS FOR ANY AND ALL JOBS

Just what you have been waiting for! A compact and efficient electric workshop for you men who are handy with tools, for you mechanically-inclined men, and for you men who like to experiment and make things at home. For the first time in the history of our business we are able to put this Super-SpeedWay Shop before you at a price which you can afford. Our offer is a fair and square, straight-from-the-shoulder offer, from manufacturers of SpeedWay Portable Electric Tools, famous the world over, for more than a decade.

DON'T PASS THIS UP!

We want you to know more about this exceptional Shop. Every tool in it is high grade, built for hours of hard, rugged work. A money-maker for the small-job man. A priceless boon to the householder. Get the full particulars. Send in the coupon today!

ACT NOW—LIMITED OFFER

That's why we say—don't delay. For a limited time only we are making this special offer on the SpeedWay Shop and tools. If you want to be in on it, fill out the coupon and send it in NOW.

ELECTRO MAGNETIC TOOL COMPANY

1830 S. 52nd Ave. (Adjoining Chicago)
Cicero, Illinois

Easy Payments

Only \$10.00 down

free blue print Service

do it NOW!

SEND COUPON NOW!

<input type="checkbox"/>	Electro Magnetic Tool Co., Dept. 54, 1830 S. 52nd Ave., Cicero, Illinois.
<input type="checkbox"/>	Dear Sirs: I am interested in the Super-SpeedWay Shop and tools. Please send me full particulars about the ten-day free trial, free blueprint, and easy payment plan on the SpeedWay Shop and tools.
<input type="checkbox"/>	Name _____
<input type="checkbox"/>	Address _____
<input type="checkbox"/>	City _____
<input type="checkbox"/>	State _____



This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



Outdoor men like *Pocket Ben*

HERE'S a steady, faithful, out-of-doors companion—a friendly little pal to take along when you're roughing it.

You can rely on Pocket Ben to measure the hours and minutes faithfully. He knows when it's starting time, meal-time, bed-time—no guess-work about it.

Pocket Ben is Big Ben's brother. The family name "Westclox" on his dial is your assurance of everything true and faithful in a time-keeper.

Sold everywhere—\$1.50. With luminous night-dial \$2.25.

WESTERN CLOCK
COMPANY
La Salle, Illinois

The SHIPSHAPE HOME

Gate for Stairway

that could be adjusted to the rise or angle of the stairway and swung back against the wall entirely out of the way.

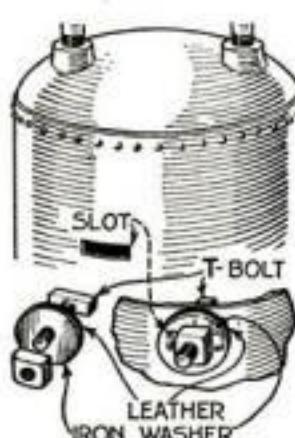
The crosspieces of $\frac{3}{8}$ by $1\frac{1}{2}$ -in. strips were placed between two $\frac{1}{2}$ -in. thick up-



rights at either end and fastened with a $1\frac{1}{8}$ -in. screw in the center of each joint. Four small screw eyes with a rod run through them were arranged to serve as a hinge. The other side of the gate is lowered into a sort of slot when the gate is closed.—ROY W. MARSH.

Patching a Water Tank

od illustrated may be used to repair it easily. The hole is drilled larger, if necessary, and given a rectangular shape with a file. Then the head of a common machine bolt is filed flat, slipped through the slot, and given a quarter turn. A leather washer is slipped on the bolt, followed by a steel washer and a nut, which is screwed up tight.—J.H.S.



A water tank repair

Windows in a Partition

an interior partition, which involves quite a bit of work if a neat job is to be done.

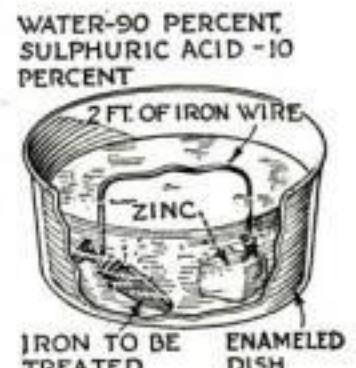
Recently I had to put two such windows in a newly erected wooden partition in order to allow more light to reach the

cellar stairs. Looking around for material, I found two discarded picture frames of about the right size. After cutting openings in the partition to take the frames, I removed the glass from them and fastened them in place with nails. A small molding was added to conceal the joints. Then the glass was replaced and held with light strips of wood.

Another way to have utilized the frames would have been to cut the openings in the partition to agree with the inside measurements of the frames and nail them flat against the wall. Either method insures neat looking windows at little or no cost.—W. L. L.

Removing Rust

A SIMPLE and effective way to remove rust from small and delicate objects is by electrolysis. Obtain a large bowl, enamel or glassware. Fill this with enough water to cover the object to be treated. Attach about two feet of iron wire to a block of zinc, and to the other end of the wire attach the object from which the rust is to be removed. Make sure that good electrical contacts are secured in each case. Immerse both iron and zinc in the water, but allow the iron wire to appear above the surface of the water. Now add about ten percent of sulphuric acid to the water; the exact proportion is unimportant.



An electrolytic process

Hydrogen gas will be given off from the zinc with vigorous bubbling, while smaller quantities of gas will appear rising from the iron object. The process usually will take two or three hours—longer if the rusting is deep. Gentle brushing with a steel wire brush will help.

When the rust has all gone, rinse thoroughly under running water, and dry quickly. Petrolatum, oil, celluloid varnish or something similar should then be applied to prevent the reappearance of the rust.—DOUGLAS LEECHMAN.

Redeeming a Garage

LAST year I built a one-car garage, with a wood siding finish and a peaked shingled roof. In the back wall of the garage, high under the peak, I placed a single window of the cellar sash type, for ventilation and light. As a ventilator it was ideally located, but from the exterior it made the garage look extremely high and unattractive.

I solved the difficulty by building an 8-ft. trellis, about $2\frac{1}{2}$ ft. wide, consisting of four uprights and horizontal members spaced so as to divide the open spaces roughly into squares. Just above the center, I cut out

(Continued on page 97)



This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

The Shipshape Home

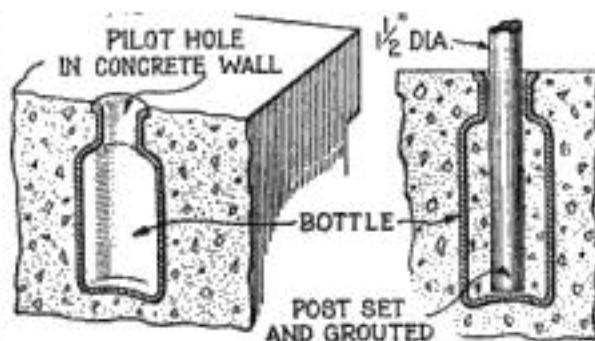
(Continued from page 96)

the inner two upright members and placed a flat diamond shape.

Now the eye no longer travels upward to the window as the only detail breaking the flat wall space, but centers pleasingly on the diamond shape in the trellis. And somehow the roof seems closer to the ground, and the wall seems just part of the picture, instead of thrusting itself to unpleasant heights. A rambler rose completes the picture.—J. F. HARDECKER.

Pilot Holes for Posts

WHEN erecting guardrails for fences where pipe fittings are to be used and the posts are to be set in a concrete wall or floor, a rigid and workman-like job may be made by placing wide-mouthed quart bottles in the cement to



Large bottles placed in concrete walls or floors to serve as pilot holes for iron guardrail posts

form pilot holes. When the concrete has hardened, the posts are set in the bottles and grouted with cement.

Bottles usually may be obtained that will receive 1½-in. pipe; if larger pipe is used, some of the concrete and glass around the top will have to be broken away.—J. A. MILLER.

Preserving Brushes

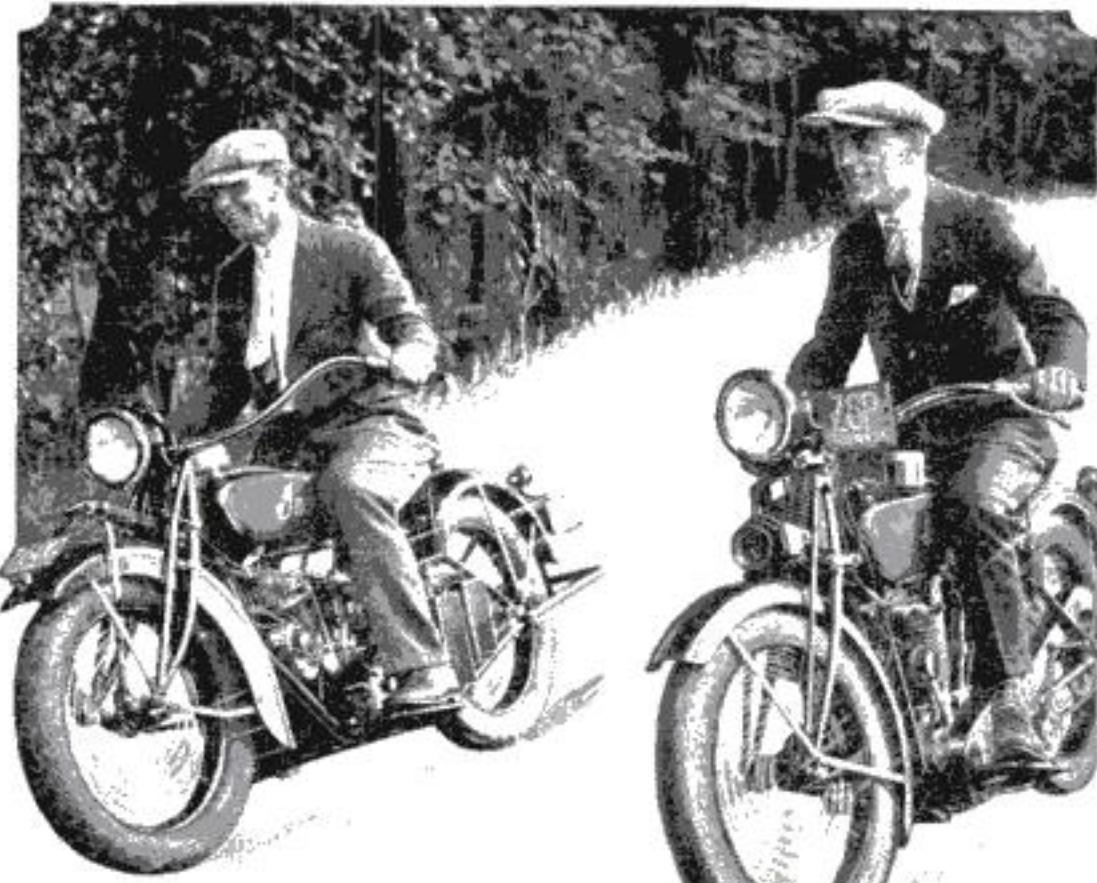
WHEN through painting, one is apt to put the brush away carefully in turpentine, linseed oil, kerosene, or "thinner," only to find, when it is necessary to use the brush again, that the liquid has evaporated and the brush is as hard as a rock.

Here is the missing step in preserving brushes: Take a piece of sheet rubber—it may be a piece of discarded swimming cap, a toy balloon, or an old inner tube. Pierce a small hole for the brush handle. Tie it tightly over the top of a glass jar or can as shown in the illustration. The preserving liquid will not evaporate so quickly and when you go back to use your brush, it will be soft and pliable.—J. L. JONES.



Rubber cover for brush jar or can

BEFORE cutting a large sheet of common window glass, look along the edges to see which face of the glass is convex. This side should be turned down on the table.



What Sport! What Fun!



-with these two famous *Indian* "pals"

All set, fellows? Here's how! For healthful outdoor sport—for comfortable travel at less than carfare—for getting quickly to business or pleasure—an Indian's your best "pal" every time!

Try either model, the Prince or the Scout. Smooth, quiet, powerful—safe! Easily handled and as dependable as your best friend. Takes you anywhere, anytime, at a fraction of carfare cost—only a cent a mile or less. Team up with an Indian—now—and know the real meaning of motoring joy!

Easy to Own

Call on your nearest Indian dealer. Let him demonstrate the Indian Prince and the Indian Scout—the two "pals" that cut the heart out of travel cost. Let him tell you about the easy pay-as-you-ride plan that enables anyone to own an Indian. The coupon below brings you—free—our illustrated catalog. Mail it today for the complete interesting story of these two famous models.

DEALERS!

{ A few good territories still open. Real opportunity for ambitious men. Write now! }

Indian Motocycle Co.

Dept. H-4
SPRINGFIELD MASS.

Check nearest age to help us suggest
the model for your requirements

THE INDIAN PRINCE The Solo Single

Learn to ride in 5 minutes. Climbs steepest hill on high. Speeds to 50 miles per hour. Low saddle. 3-speed transmission. Two-unit electrical system. Light, sturdy, 90 miles per gallon. Less than 1¢ per mile operating cost. Price with complete electrical equipment \$225 F.O.B. Springfield, Mass.

INDIAN SCOUT The Solo Twin

Twin-cylinder smoothness, acceleration and power, combined with light weight, low saddle, ease of handling, 65 miles per gallon. 1¢ per mile. Highest used-value. Thousands delivered 7 years ago in use today. Price with complete electrical equipment \$285 F.O.B. Springfield, Mass.

Motor the Indian Way

Lowest initial cost!
Lowest upkeep!
No garage bills!
No traffic delays!

Indian Motocycle Co.,
Dept. H-4 Springfield, Mass.

Send me your illustrated Catalog describing
the Prince and the Scout.
 Check this square if you are interested in
our money-making proposition to dealers.

Name _____

Address _____

City _____ State _____ Age 12 to 16 16 to 20 over 20

IF YOU CAN USE AN EXTRA \$20.00 BILL

write for
this

**FREE
BOOK**

YOU can save
\$20.00 in no
time by using



SMOOTH-ON No. 1

to do your own household repairing—and in addition you will have that proud "I-did-it-myself" feeling.

Here is what one enthusiast did with two 35 cent cans:—A \$25 lamp stand loose in base, two big leaks in heating furnace smoke pipe, loose hammer handle, and three loose hooks in tiled bath room wall were all put into good usable condition at an average cost of 10 cts. for each repair—and \$20.00 easily saved over what would have been paid to professional fixers or for new parts.

By using Smooth-On to make dozens of the simple repairs necessary in every home, you can save enough to pay your radio upkeep, buy yourself or your wife a camera, a bull pup or some other pleasure giving article that you would otherwise hate to spend the money for.

On the Automobile

Smooth-On No. 1, being unaffected by water, oil, gasoline or heat, is also excellent for automobile repairs. Try it for stopping radiator, tank, pipe line and hose connection leaks from the outside, keeping exhaust line connections tight to prevent the escape of obnoxious burnt gases, repairing cracked water jackets and crank, gear and differential cases, keeping grease cups, lubricator connections, nuts and hub caps from loosening and falling off, tightening loose hinges, robe rails, etc.

The FREE Smooth-On Repair Book

will show you how an astonishing number of home and automobile repairs are as easy for you to make as for somebody else.

Mail the coupon for a free copy and get Smooth-On No. 1 in 7-oz. or 1 or 5-lb. can from any hardware store.



Smooth-On Mfg. Co.
Dept. 58, 574 Communipaw Ave.
JERSEY CITY, N. J.

Do it with SMOOTH-ON

SMOOTH-ON MFG. CO., Dept. 58,
574 Communipaw Ave., Jersey City, N. J.

Please send the free Smooth-On Repair Book.

Name.....

Address.....

**Return this coupon for a
FREE copy of Booklet**

Bench for Small Soldering and Hardening Jobs

By HENRY S. LARABY



The bench contains a stand for the blowtorch, a furnace, a pilot gas flame, swinging oil and water tanks, drawers for holding soldering supplies, a file rack, a holder for tongs, and other equipment

OLD MAN WILSON was so absorbed in watching the flame in his new "hearth" that he did not notice the shadow cast by a visitor.

"What in the world is this you have?" his visitor asked.

Wilson, although somewhat startled, kept his hand on the gas control to the torch as he looked around. He grinned on recognizing his friend.

"This is my new toy," he said with the same pride he would have shown in mentioning a new car.

"Well, it looks as if all the playthings are right at hand!"

"Certainly! That is what I wanted. We have needed something like this for a long time, so finally I got the lumber and had one of the apprentices build the bench in odd times. We had most of the equipment about the place. How do you like it?"

"Seems convenient for such work as tempering and soldering."

"You are a good guesser," Wilson returned. "We call it the 'blow torch bench,' but it is really a hardening and soldering outfit. See, we put it where

there is good light, gave it a sheet iron top, and built a little furnace at the correct height to save stooping. Oil and water are in buckets arranged to swing out of the way, so they won't be kicked, and there are drawers for solder and flux, and the like."

"The gas torch is mounted on a stand so that we can adjust it to heat anything we can put in the furnace, or we can use the torch to heat work held in the vise. The furnace has a hole in the top for soldering irons, and the fumes go out the same hole instead of blowing back in your face. There is a pilot flame going all the time so it takes no time to light the torch."

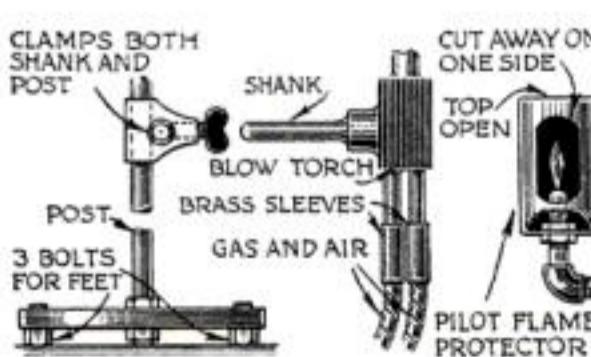
"I have been wondering if some such arrangement would not fit in well in my basement at home?"

"Sure thing," Wilson replied. "The whole thing is made of two by sixes put together with bolts and lag screws. You would not have compressed air as we have, but you could get a satisfactory bunsen burner for small work. A combination like this would be fine for any sort of shop, large or small."

"It certainly looks good," the visitor agreed.

Drilling Very Hard Steel

TO DRILL a piece of very hard steel, even when tempered, try the following if other methods have failed: Take a carbon steel drill, grind as required, heat to a bright red, dip in powdered rosin about five seconds, and then plunge into a water bath. Use turpentine for a coolant. I have found that this will do the work four times out of five.—H. J. C.



Details of standard and clamp for supporting the blowtorch; construction of the pilot burner

Old Bill says—



ENGINEERS and machine designers often can save money for their firms by getting acquainted with the shop force.

The man in the shop is in a position to see where time or materials may be saved, sometimes by a trifling change in the design of a part.

Lathe spindles have a peculiar tendency to wear out of round because of the pressure of the cutting tool on one side; this is noticeable when a hole that has been bored to close measurement is found to be out of round and tapered.

A worn lathe spindle usually will bore holes that are tapered with the front end large.

Poor work may result also from the wearing of the carriage ways.

Never pass by any evidence of danger or accident without correcting or reporting it; your own life and the lives of others may be at stake.

A good machinist is always a careful workman.

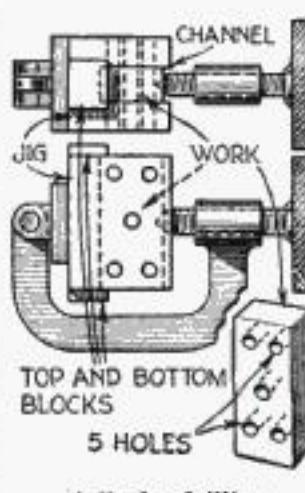
Automatic lathes have taken a lot of work away from the engine lathe, but after all the engine lathe is the most economical all-around machine for general work.

Equipped with a few inexpensive accessories, a lathe sometimes can compete as a production machine with high priced special machines that are of no use for other work.

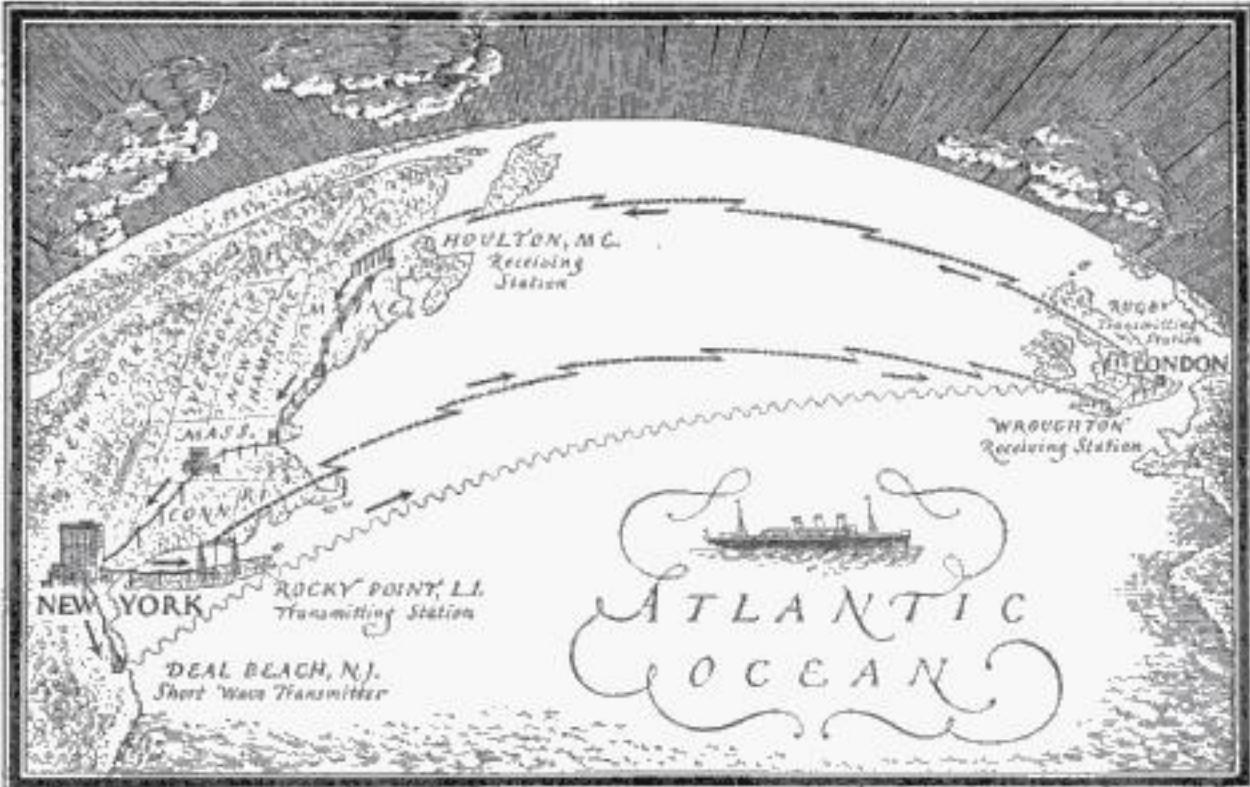
A gage should never be forced to obtain a fit.

Do every job as quickly as you can, but don't forget quality in your eagerness to pass on to the next job.

Quick-Acting Hinged Jig



FOR drilling five holes in the small block, a hinged drill jig was devised as illustrated. The work fits in a channel section that is provided with guide holes and is clamped with the knurled screw. The jig is swung open for cleaning and loading. —FRANK N. COAKLEY.



The Radiophone's Meaning

*An Advertisement of
the American Telephone and Telegraph Company*



AN ADVENTURE in communication was made last January when transatlantic radio telephone service was established between New York and London. There had been previous tests and demonstrations. Nevertheless, the fact that at certain hours daily this service was made available to anyone in these cities from his own telephone, created such public interest that for several days the demands for overseas connections exceeded the capacity of the service.

It was then demonstrated that there was a real use for telephone communication between the world's two greatest cities. It was further demon-

strated that the American Telephone and Telegraph Company, with the co-operation of the British Post Office, was able to give excellent transmission of speech under ordinary atmospheric conditions.

In accord with announcements made at that time, there will be a continued effort to improve the service, extend it to greater areas and insure a greater degree of privacy.

It is true that static will at times cause breaks in the ether circuit, but a long step forward has been made towards international telephone communication and more intimate relationship between the United States and Great Britain.

Make More Money

Read the Money Making Opportunities on pages 116 to 143 of this Issue.

Let Boice Help You Build It!

Men everywhere are finding it easy to build things with Boice-Crane Bench Machines and books of working drawings. Send 10c for Boice's new booklet. Contains helpful information and full description of Boice-Crane bench circular saws, band saws, jig saws, lathes, jointers, drills and mortisers. Also gives list of books containing over 250 working plans of all sorts of furniture and toys.



14" Band Saw

Table 12" x 14"
tilts 45° deg.
Saws 7" stock.
Uses blades 1½" to
1½" wide.
Bronze Bearings.

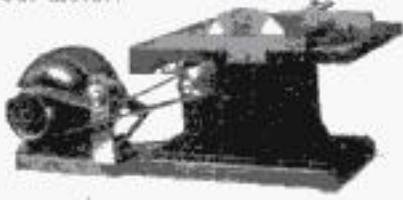


8" Bench Lathe

Does turning, drilling, threading,
sawing, sanding, grinding and jig
sawing in wood or soft metals.
Swings 8". Capacity 19" between
centers.

All Boice Machines driven by 1/4 to 1/2 H.P. motor attached to light socket. Send 10c for booklet today.—NOW!

W. B. & J. E. BOICE Dept. P. S. 4-C
Toledo, Ohio



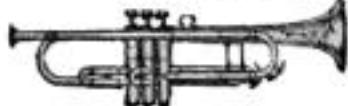
Junior Saw

Does ripping, mitering, grooving, sanding, grinding and drilling with ease and accuracy. Table 10" x 13". Saws 2 1/4" stock. Dadoes 3/8" x 3/8". Makes moulding. Sold with or without motor.



Reginald Denny and Dorothy Gulliver, two of Universal's most popular film stars. Denny's latest success is "Fast and Furious." Dorothy Gulliver appeared in "The Collegians."

Lyon & Healy
Continuous
Conical Bore
Trumpet



Washburn
Tenor
Banjo



Or play one of these!

Lyon & Healy Trumpet, "Conical Bore" throughout. Easier to play. The most remarkable professional instrument ever produced. In silver with gold bell, \$110.00. In case. Washburn Banjo, the most musical, resonant, far-reaching (by test) professional banjo made. \$60 to \$90.00.

Lyon & Healy

Everything Known in Music
79 E. Jackson Blvd., Chicago

"Don't envy the other fellow his good times and popularity. Here is a saxophone you can learn to play quickly and easily. Take my advice and get one!"

Reginald Denny

You—who have always wanted to play some kind of musical instrument—pay attention to Reginald Denny's advice. Learn to play the most popular instrument of all—a saxophone. Here is your chance to win pleasant evenings, new friendships, extra pocket money for yourself. If you can whistle a tune you can play this new Lyon & Healy Sax.

Amazing Beauty of Tone!

You learn quickly because we have simplified the fingering, made it easy for you to play, easy to produce full, rich tones. That's why amateur musicians like Denny prefer the new Lyon & Healy. Leading professional players in famous orchestras are delighted with its accurate adjustment, improvements in key action for hair-trigger finger work, exactness in pitch and resonant and mellow tones. Completely made in Lyon & Healy's own factories and guaranteed by this, the most famous music house in the world.

Easy Payments!

Learn how easy it is to purchase one of these professional instruments on our special time-payment plan. Many write they pay for theirs out of extra pocket money earned by playing as they pay.

Free Instructions!

Free Trial Use coupon for details of six-day, Free Trial, Free Lessons Offer. Teaches you to play tunes without learning written music. Not obtainable anywhere else. Free, with a Lyon & Healy Sax.

Mail coupon today

LYON & HEALY, Inc.
19 E. Jackson Blvd., Chicago
Send free your new Saxophone Book with details of Free Trial Offer, "Easy to Pay" plan and Free Instructions.

Name _____

Street _____

City _____ State _____

Instrument _____

Anyone CAN LEARN!

No talent or experience necessary. Earnings work. Pays big money. Complete instruction book TELLS HOW TO MIX PAINTS, Show Cards, Window Board and Wall Signs, Ready-made letters, Gilding, TRICKS OF THE TRADE, also gives 100 Alphabets and Designs. Book bound in flexible lnt. leather, gold edges, and four half-bound Show Cards. Pens, Book and Pens sent postpaid for \$3.00. (C. O. D. 10c extra.) Ogilvie Pub. Co., 57 Rose St., Dept. 72, New York

EARN MONEY IMMEDIATELY—WE FURNISH EQUIPMENT TO START

NO JOKE TO BE DEAF

—Every Deaf Person Knows That I make myself hear, after being deaf for 25 years, with these Artificial Ear Drums. I wear them day and night. They stop head noises and ringing ears. They are perfectly comfortable. No one sees them. Write me and I will tell you a true story, how I got deaf and how I make Medicated Ear Drum you hear. Address GEO. P. WAY, Artificial Ear Drum Co. (Inc.), Hoffman Bldg., 2539 Woodward, Detroit, Mich.

New Improved SPORS Fountain Pen. 60 Day Trial. Money back if not pleased

AGENTS SAMPLE 65¢ SELLS FOR \$1.25. Writes Like a \$7 Pen

Many Make \$10 Daily Easily

Comes in Red or Green
GUARANTEED 2 YEARS
Improved Point

FREE

New and unusual Mail Order Distributing Plans and Large Wholesale Specialty Catalog showing best sellers from all parts of the world.

E. SPORS CO., 127 Fourth Street, LESUEUR CENTER, MINN.

Ways to Do Recessing

(Continued from page 76)

tools should be ground, or set in relation to the work?"

"It depends greatly on the job," replied Grimes. "This job you have here is nothing but a boring job so you simply set your tool slightly above center and grind it as you would for boring a finishing cut in cast iron. If I were doing the job, however, I would run the turret forward to a stop for the proper length at C (Fig. 1); then feed the tool by hand for depth of recess, and finally use a reverse feed of the turret in the direction of the arrow D."

"Why use the reverse feed? Is it any advantage?"

"Don't you see, Harvey, a pulling cut is less likely to 'chatter' than a pushing cut, especially with a more or less flexible bar. Therefore I would pull instead

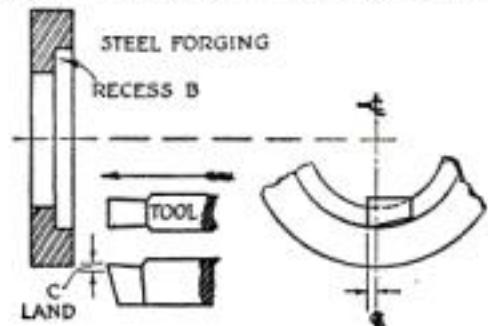


Fig. 4. Without a "land" at C, the recessing tool would dig in badly

of push. The spring of the bar in a push cut makes the tool *dig in*, but when using a pulling cut, it springs away from the work."

"I see what you mean," said Harvey, "but I'm going to try it both ways and notice the difference."

"**A**LL right, Harvey, I'm going up to the engineering department for a little while, I'll stop and see you when I come back."

Harvey got his machine set up and started on the work just as Grimes returned.

"You're just in time," Harvey remarked. "I'm going to recess this one with a push cut."

He started the tool and fed it in toward the chuck without any apparent trouble.

"There," he said, "it doesn't seem to chatter!"

"Let's look at it when you take it out of the chuck," suggested the older man.

So when the recess was finished, Harvey took the piece and held it up to the light.

"Do you see the chatter marks all along the inside?" Grimes asked.

"Yes, sir, I do," acknowledged Harvey, "but they don't do any harm, do they?"

"Any kind of chatter is bad, because it indicates vibration," was the reply, "and this is harmful for both tool and machine. Try it the other way now and see if it isn't better."

So another piece was recessed using a pulling stroke and afterward inspected in a strong light. To Harvey's surprise there were no chatter marks apparent.

"I guess you win again; it's certainly better this way," the youthful machinist said heartily.

"It's a good thing, Harvey, to avoid vibration, no

(Continued on page 101)

Ways to Do Recessing

(Continued from page 100)

matter what kind of a job you are doing. For example, in a case like this (Fig. 3), the work A has a recess at B for the thread, and while the recess itself is not important as far as accuracy goes, the tool C would have to be sharpened pretty frequently if there were any chatter."

"Why, we have a job similar to that," said Harvey, "in one of the big gland nuts on the number six compressor. I've done that job several times and always have had trouble with the recessing tool. I would be glad to know how to avoid it."

"Well, Harvey, look at this enlarged section of the work at D. Here's the tool E which must be above center with clearance as indicated. If the cut is deep, stone the tool a little all around just under the cutting edge at F to give it a little 'land.' If you do this, you won't be likely to have any trouble."

"What's the idea?"

WHY, the little 'land' acts as a support under the cutting edge and prevents the tool from digging in."

Grimes walked over to a pile of forgings (shown in Fig. 4) and picked up one.

"Here's a good example right here," he said. "You have a lot of metal to remove

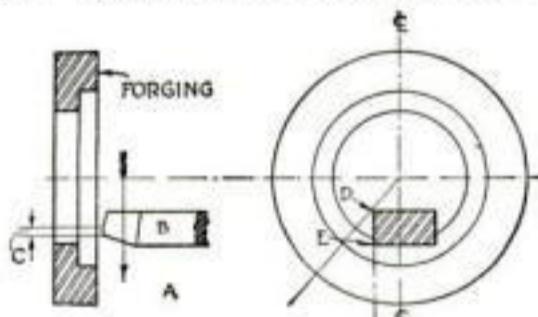


Fig. 5. Facing steel with tool set well above the center to give a clean, shearing cut

when you cut that recess at B, and if you are not careful, your tool will chatter badly."

"Well, I'm not going to do that job, so I should worry."

"Oh, I thought you were anxious to learn all you could," Grimes chuckled.

"Now, you know I didn't mean it that way!" Harvey exclaimed in apologetic haste.

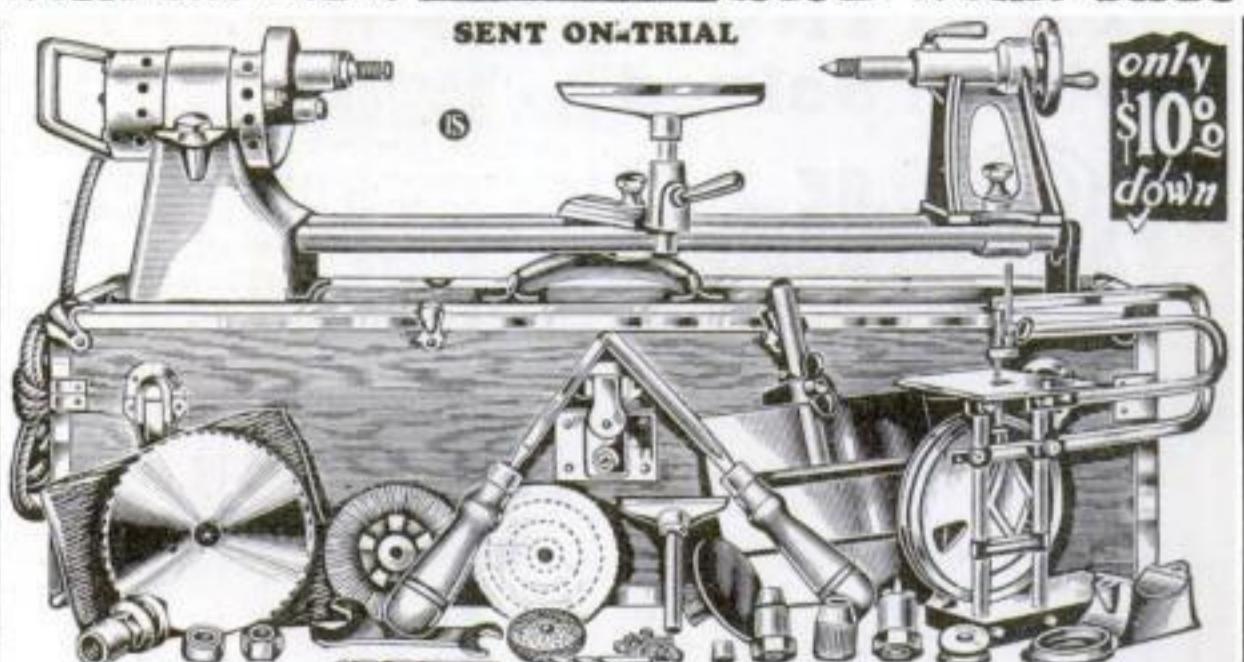
"I've already given you the idea. Let's see you apply it."

"Do you mean that I would stone a 'land' at C on the end of the tool?"

"THAT'S the idea exactly," answered Grimes. "The land will prevent the tool from digging in even under the pressure of quite a heavy cut. If you feed the tool in the direction of the arrow, it will certainly chatter unless you dress it as I have suggested. Then again, in a facing cut which will have to be made across the same piece (Fig. 5 at A), the machinist will have another chance to use his head. In grinding the facing tool B, if he grinds a little 'land' at C and feeds the tool outward, he will get a smoother cut and less chance for chatter."

"Should a facing tool be set on center or not?" asked Harvey. "I shouldn't think it would" (Continued on page 102)

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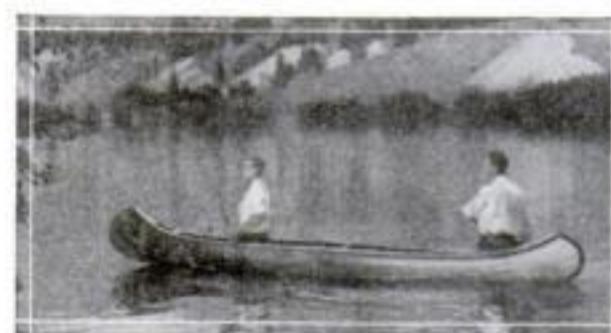
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Ways to Do Recessing

(Continued from page 101)

make much difference on that kind of a cut."

"On cast iron it doesn't make much difference," Grimes answered, "but on steel, if you set the tool considerably above center, you get a shearing cut (as shown at D) and the chip separates from the metal with a smoother cleavage."

"I'll try it out on the next job I get," promised Harvey.

A Two-in-One Packing Tool

FOR packing the bonnets of globe valves and other small stuffing boxes, a handy tool may be made from an old Ford engine valve. It is split for about 1½ in. One prong is drawn into a small hook for starting and ripping out old packing; the other side is drawn to a blunt point for pressing in the new.—F. W. BENTLEY, JR.



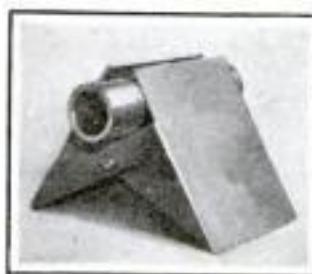
The tool is made from an auto engine valve

Making Small Faceplates

FACEPLATE castings for very small lathes are not always available, but ordinary iron pipe flanges answer the purpose quite as well. Obtain a flange with a hole small enough so the threads can be drilled or reamed out; then tap or taper the hole to fit the nose of the lathe spindle. Put the flange on the spindle first with the back side out and turn it, carefully forming the surface that comes against the collar, if the plate is one that screws on; then reverse and turn the face and edge. The iron is soft and machines very easily.

Sometimes blank flange castings can be obtained, which makes the work somewhat easier and allows more latitude in the size of the hole for the spindle nose. Chuck mounting plates can be made in the same way.—HOWARD GREENE.

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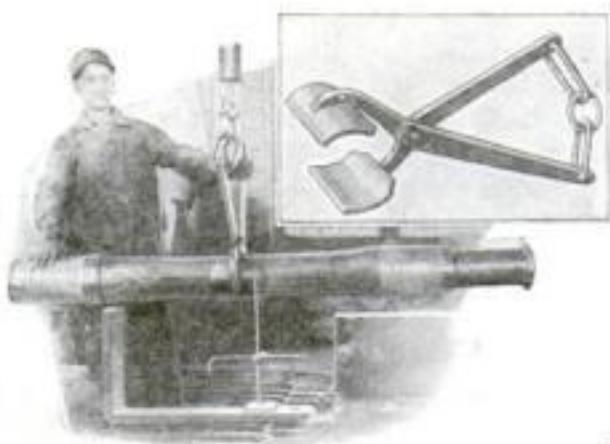
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Window Shade Used As Cover for Drawing Board

EVERYONE who has left a drawing board overnight knows how disagreeable it is to return the following day and find the drawing covered with dust and dirt. Sometimes a loose cloth is put over the table, but that is likely to blow off, or to carry instruments with it when taken off.

A good scheme for protecting the board and tools is shown in the accompanying



Window shades are mounted on these drawing boards so that they can be covered quickly

illustration. A window shade roller is fitted to the back of the board so that the shade may be pulled over the drawing. It is readily rolled out of the way, and if the front end is lifted about a foot from the board, it will roll up without disturbing drafting instruments, reference sheets or anything that may be on the board.—AVERY E. GRANVILLE.

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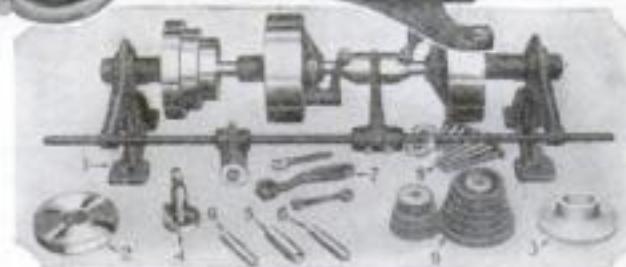
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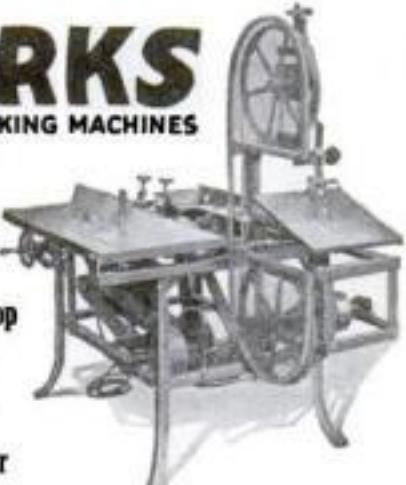
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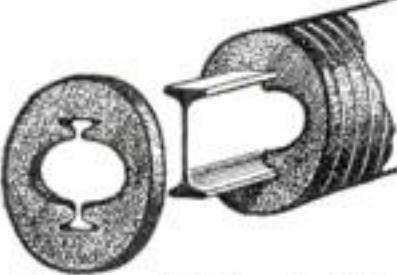


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A Job for One in a Million

(Continued from page 13)

cracked motor and were lost for four days in the Everglades. Their only companions were rattlesnakes and vast swarms of mosquitoes. All that stood between them and starvation were a few bars of chocolate and two cans of beans. Finally they were found and rescued by one of a number of airplanes sent out to search for them.

LAST year Smith again was in the tropics engaged, with T. Glass as pilot, in photographing territory in the vicinity of Tampico, Mexico. They were flying low over bushy country where bandits had been reported, when they suddenly were made the target for pot shots below. All at once they felt the plane shiver, and they knew it had been hit.

Glass completely cut off the motor and glided down, and no sooner had they landed than a dozen armed bandits rushed toward them. The airmen, unarmed and powerless, thought they were done for. The Mexicans, however, were immediately struck by the strange instrument which the fliers seemed to guard so carefully, and crowded around the camera in childish curiosity. Glass, who could speak a little Spanish, tried to explain that they were merely photographing the territory for a Mexican company. Both men, however, were held prisoners for several days before negotiations with the bandits brought about their release.

The experiences of Major Hamilton Maxwell in making close-up photographs of Niagara Falls and the Gorge in July, 1920, illustrate how iron nerve alone sometimes carries the photographer through a ticklish job in the face of danger. From the moment he and Ford McCarthy, the pilot, took off from a small field on the Canadian side, the thrills began.

"THE field was much too small for our plane to get out of with the heavy load we were carrying," said Major Maxwell, describing the trip. "To clear it, we had to zoom over some seventy thousand volts in power wires at the far end. These wires were forty feet up, and we didn't leave the ground until we were about fifty yards away from them. Never will I forget my feeling of relief when I looked back to see the tail skid clearing the last wire by about one inch!"

"Such a beginning left me none too calm for the job I had undertaken. However, we had to get the photographs. And then, when we flew down close to the falls, we ran into violent bumps, the like of which I have never felt before or since. We were drenched with spray. I became violently ill. To make matters worse, McCarthy, in his zeal to get me in position for the photos, made the old ship do Immelmann turns and nearly every other flying trick during the twenty-five minutes we were there. The last straw was when McCarthy decided to finish up the job by flying under the Suspension Bridge. The rest of the trip was virtually a blank, until I found myself lying on my back at the flying field in

Buffalo. But I got my photographs; one hundred and forty of them."

In Uncle Sam's Navy is one old-timer who has survived a dozen close calls, not the least of which was an almost miraculous escape in the *Shenandoah* disaster. He is Lieut. W. L. Richardson, chief photographer for the Bureau of Aeronautics. When the Ohio storm sent the "Daughter of the Stars" to her doom, Richardson managed to cling to the careening wreck until it crashed to the ground. Then, his right ankle caught in a wire, he was dragged downhill underneath the ship. Only by rare luck did he survive.

AT ANOTHER time Richardson went aboard the dirigible *Los Angeles* to take charge of naval photographers detailed to make photos of the solar eclipse of January, 1925. And at what risk! Mounting cameras on top of the dirigible, Richardson and another photographer, Peterson, calmly took still and motion pictures at a height of 8,000 feet, and at a temperature far below zero. Their faces were frozen, but they stuck to the job.

Another world famous air photographer is Captain A. W. Stevens of the Army. Perhaps his greatest exploit was the history-making flight of 1924 when, in a plane piloted by Lieut. J. A. Macready, he photographed the city of Dayton, O., from an altitude of 31,500 feet, or nearly six miles, which at that time was a two-man world record. One photograph covered an area of nineteen square miles and included almost the entire city of Dayton.

Less than a year later, Captain Stevens, as a member of the Alexander Hamilton Rice expedition into the jungles of Brazil, risked his life in a flying boat to take photographs of territory never before seen by white men. With Lieut. Walter Hinton, who piloted the Navy plane, NC-4, across the Atlantic, as pilot, he penetrated 120 miles farther into the dense jungles than any other explorer ever had gone. Traveling light, neither man carried any firearms. A machete and an ax were their only weapons in case of a forced landing, and these would have been almost useless against the poisoned arrows of the savage tribes which infested the region.

THESE are typical of the kind of men who are following the fascinating new profession in increasing numbers. Yet none of them are foolhardy adventurers. To them the science of mapping the earth from the sky is a real man's job. Most of them are married, and many of them are rearing families.

This summer, undoubtedly, there will be trans-Atlantic flights between New York and Paris; perhaps a flight around the world for a speed record. Certainly there will be more expeditions into the Far North. And you may be sure that plenty of camera men will be applying for places in every one of these expeditions.

Tishy

(Continued from page 105)

longer wait, with slow, careful turning of the sextant tangent screw. Then Tishy did an amazing thing. He leaned against the rail, stared upward at the bridge, where Debron stood peering out at the lightship through the chill blackness, and laughed quietly.

"LET him find out. It's a man's job!" he muttered, and again tried for the star, got it, and went below to work out the position from the result.

When he got the position line ready from his observation, Tishy smoked a cigarette before going to the chart room to lay it down on the chart. Debron, of course, had a line, too, but since he had picked up the light he would probably not be in any hurry about laying it down. Through the darkness astern the light of the windjammer blinked fitfully. Windjammers were never famous for the quality of their lamp oil. There was a whine in the air, although the snow had stopped, and the running seas overside had a queerly vicious look as they curdled along the black steel hull. Tishy threw the cigarette butt over the side, and started toward the chart room. Passing the bridge ladder he heard the captain's voice above.

"That lightship is adrift! Stop the ship and take a bearing."

Tishy went inside smiling. He had seen that the lightship was adrift. Debron had not. The Old Man had found it out. That would fix Debron. The big, cocksure fellow would hear all about it in the morning. It was a good thing the passengers were all asleep. There would be nothing to worry about, since he, Tishy, had a fix which would at least help to place the ship. But when he laid off the position line on the chart, Tishy lost his smile. He stepped outside quickly. Sought for the light, and could not find it. Instead, there was a small light such as an anchored vessel shows on her forestay. The lightship's people had discovered they were adrift. And almost at the moment when Tishy discerned that small light, there was a shout from aft, that the momentarily forgotten windjammer in tow was close under the stern, unable to stop when the steamer had stopped for the bearing. That old wreck, down by the head with ice, was simply unable to sheer clear once the pull of the towline let up.

"Slow ahead, port. Helm-a-port," the captain ordered, and the big steamer began to move in a short arc. Then the lookout in the foremast crow's nest, ignoring the speaking tube in his excitement, yelled:

"Breakers ahead and to port!"

TISHY was at the bridge ladder. He felt guilty. He had never meant to let Debron get into quite that fix.

"Hard a-port! Full ahead port engine, half ahead starboard," the captain cried, anxiously, peering out into the blackness where a venomous white line seemed suddenly to stretch away.

The steamer forged ahead, gathering speed. "Look out aft, there!"

The towline twanged tight. It snapped where the ice of the windjammer's bows cut it. The shock of the breaking wire was felt forward, but not nearly so tremendously as was the following shock when the wire fouled the steamer's propellers as she turned.

The terrific jar shook the steamer. Officers' doors opened. That rumbling crash would awaken the Seven Sleepers. The helmsman in the wheelhouse said, in a cool, duty tone:

"She don't steer, sir."

"Quartermaster! Call the chief officer," the master said. Tishy was at his side. "Get an anchor down quickly! Have the other clear. Debron, see all hands are called. Stewards too. Got to keep the

(Continued on page 106)

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the finest heat
treated tungsten
steel to insure
longer cutting life



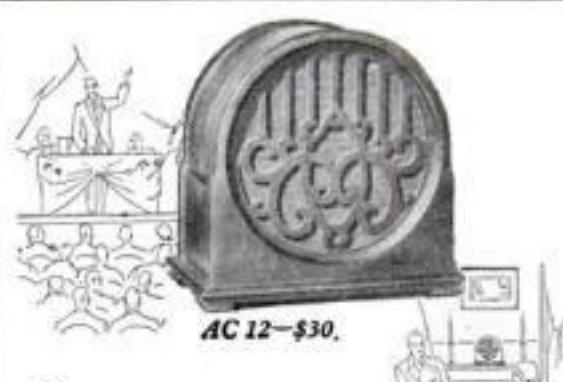
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Pole with Byrd*

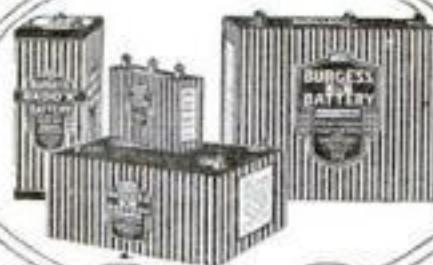
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BURGESS RADIO BATTERIES

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Tishy

(Continued from page 105)

passengers from going batty. See what the tow's doing, quartermaster."

In the glare of great cargo arcs quickly fixed and lighted, the scene was revealed as in sunniest daylight. Tishy and his gang forward, letting go an anchor. The lightship, its riding light flickering, anchored well clear of the breakers. The windjammer swinging along with her head bowed down under her burden of ice, perilously close to the *Diadem*, nearer yet to the menace of the reef, her forlorn crew futilely attempting to chop the ice from her forecastle head to get at her anchors before she went utterly to wreck. Sparks, in his little shack, seen through the open door, calling, calling, through the ether for assistance. A blinker lamp on the lightship telling the windjammer to anchor, and an old man on the windjammer waving his arms in picturesque appreciation of the irony. Decks rapidly filling with frightened passengers, awakened by the crash of the lost propellers, and sent into a mild panic by the sudden terrific rolling of the steamer as she turned to the sea. Stewards going among them, assuring them that there was no danger. Many passengers accepting that assurance. Three hundred terrified steerage people refusing to believe, making a noisy rush for the boat deck, redoubling their noise in the glare of the great arc lamps.

TISHY doubled aft when the anchor definitely held and the steamer stopped drifting. He could take in every bit of the scene. It was no comfort to him. How well he could see that all of it was up to him! Had he not been so bitter, he would have told Debron that the lightship was adrift the moment he saw it by his sextant angle of the moving light with a fixed star. Then the course could have been altered without fuss; the tow would not have moved up, slackening the line; the towline would not have snapped without that abrupt shock of tightening again; the steamer would not have lost her propellers, nor need that old windjammer, with her stubborn old man and courageous crew, be at that moment drifting fast to destruction in the breakers.

As he recalled it all, a savage anger seethed through him. For that moment at least he justified himself, blaming Debron. If Debron had not been so officious about that lifeboat job; if Debron had never been so damned patronizing; if Debron had not been so clever with his nicknames—Tishy plowed through a swarming mob of steerage folks, all screaming and fighting about the boats, refusing to listen to the stewards or seamen. Tishy seized hold of the first one he collided with.

"Speak English?" he yelled. The man answered in a mouthful of gutturals. Tishy tried another. He tried many, then a man answered with a stomachy, rumbling "Yaw."

"Then tell 'em the ship's anchored, that they're safe. Go on, shout it out before somebody's killed."

THE man bawled the assurance. There was something magical in the mere word, "anchored." Others took it up. Soon the mob roar was leavened with voices preaching security. A few refused to believe. Some milled about the forward boat, and as he fought his way through, to get to the bridge ladder, Tishy saw Blanche Torrey and her father pressed against the rail. The girl was pale faced, but holding a brave front. The old fellow seemed to have shed his invalid's role in the emergency and was doing his poor best to protect his daughter.

"Oh, here's Mr. Burton, father! He'll look after us," the girl cried, and Tishy felt the hot blush flooding his face. What a fine protector he had shown himself to be! Even that old colonel, age, weakness (Continued on page 107)



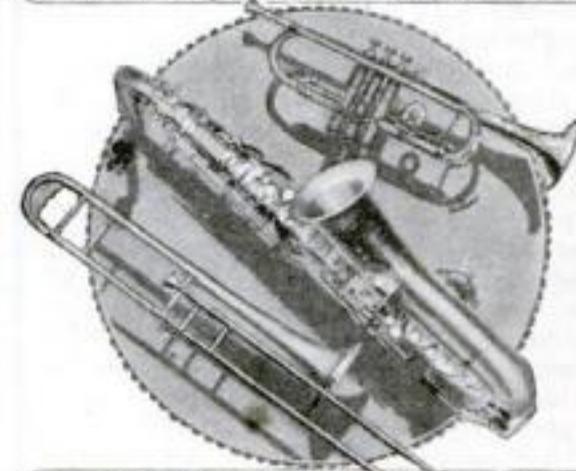
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Tishy

(Continued from page 108)

and all, was proving a better man in the pinch. He was being hustled about, and was clearly not strong, yet he thrust back the rabble, facing them with glittering eyes that shot indignant fires straight down his eagle nose, calling them outrageous names which they could not understand. Tishy darted to his room, got his pistol, and was back beside the boat in two minutes.

"Take this, colonel, and use it if you must," he snapped, and then went up to the bridge with his report that the steamer was securely anchored. Thick flakes of snow fell athwart the blackness of the night outside the arc light glare. The captain anxiously watched the drifting windjammer, receiving Tishy's report with the curtest nod. That old sailing ship was fast passing beyond the limit of assistance. On the lightship the blinder had ceased its futile signaling; the crew were trying desperately to get their boat launched. It was frozen up solid, just like the windjammer's anchors and gear.

HURRY with that boat, Debron!" the captain shouted. Tishy started, followed the captain's gaze, and saw that which shocked him back almost to the bitter mood he had but lately cast off. Debron and a crew fought to clear away a boat, and the frenzied mob, only just reassured by the steamer's anchoring, once more went crazy at sight of an officer and men trying to lower a lifeboat. It was useless now to tell them there was no danger. Useless to tell them only a rescue of that windjammer was intended. What had they to do with the windjammer? If she struck, what of it? Were they aboard of her?

But what Tishy saw more vividly than anything else, was that Debron again had been chosen to take a line across to the imperiled ship. He saw, too, that Debron could never get that boat away in time to save the windjammer from striking. If she struck, in those roaring breakers, there was small chance that her plucky old skipper and crew could be saved. And it was all because Debron's sense of humor created "Tishy" as a nickname. That was what Tishy tried to assure himself, while swiftly seeking for a solution.

"Jump down there and help Debron beat off that rabble," said the captain to Tishy and the two junior officers standing by.

"That's no use. Too late," muttered Tishy, and took the ladder in one footless slide, hands on the handrails. The juniors followed, hurling themselves into the mob, and speedily swallowed up by it. Tishy had seen where the bos'n had prepared coiled small lines, ready for the boat. He was lost to sight for a moment, as the juniors had been. But soon a shout went up, and men who a moment before crazily mobbed the lifeboat craned their necks to peer out upon the hissing sea. The old colonel fired a couple of shots into the air in his excitement, and perhaps they did more to quiet the mob than any amount of manhandling. And then up went a shout that made the other sound like the sigh of a zephyr. Debron uttered it.

TISHY'S crazy! He'll never make it! Swing out this boat, lively, or he's gone!"

Perhaps Tishy heard. Out there in the icy seas, swimming like an otter, with a heaving line snaking out after him. He flogged the water fiercely, shaking his head to clear his eyes each time he emerged from a soaring crest. And the same men Debron had stationed at the stern of the steamer to clear away and pay out, the lines, did that service now for the swimmer, awed into amazing alacrity by sheer shock. Of all the *Diadem's* crew, Tishy was the last they expected to pull off a stunt like that. That was another result of Debron's humorous nomenclature.

(Continued on page 108)

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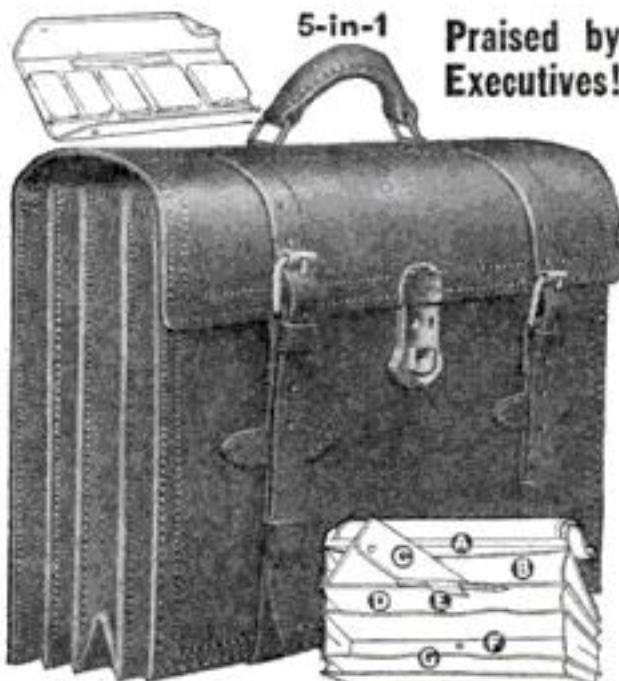
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\$25 IN PRIZES—See Cash Prize on Page 116

Tishy

(Continued from page 107)

But Tishy was well away. The windjammer swallowed down the wind, past the steamer, and at the nearest point was no more than fifty yards distant. But she moved fast. The reefs were not much more than a hundred fathoms astern of her. Debron could not get his boat clear. Passengers who before fought to get to the boat, now hung in a mob about the rails and davits, gaping at the little speck out in the biting cold sea which was a human being like them.

"My Lord! He's a gone goose, and so's the windjammer!" That was the captain, up there on the bridge, full to overflowing with worry enough.

"They see him! They've got a line to him!" Thus the bos'n, tending the lines.

"Oh, father! Tell me. I daren't look!" This from Blanche Torrey, hiding her face against her father's coat. Then in the next moment bravely facing whatever might come, scanning the water, biting her lips.

"IN WITH you, lads! Lower away smartly!" Debron at last had his boat clear. But too late, unless Tishy had got his line across. The boat was lowered, just the same. And the windjammer seemed to swing faster towards the breakers. Then a line snapped up from the sea. A shout from aft. Men aboard the windjammer frantically hauled in the line. The bos'n's gang flung out coil after coil of bigger lines; and these, too, were hauled over until a hawser stout enough to secure the windjammer to the steamer was gotten hold of. But the windjammer's stern was at the fringe of the surf. A black shape was rising halfway up the frozen side of her on a rope, and suddenly dropped back into the sea.

"He's gone!"

"Threw himself away, that he did!"

"The old ship's into the breakers, too!"

Debron had headed the boat straight for the windjammer. Low down on the water, he had not seen Tishy fall back and go soaring away into the blackness. The after winches of the steamer were rattling in the heavy rope, slowly, steadily dragging the old ship back from the jaws of destruction into which Tishy had vanished.

The old skipper of the windjammer was gesticulating and bawling at Debron, whose boat was near swamping under her as she came up to the pull of the winches. Then Debron started his men rowing again; and the boat, too, disappeared into the murderous chaos beyond the arc lights' radiance.

"That boat's gone, too," muttered the captain of the *Diadem*. "Two fine fellows lost for an old derelict that ought to have been abandoned at first!"

"Call's picked up, sir. Two ocean tugs coming out," the wireless operator announced.

"That won't save my men!"

WITH the old windjammer hauled clear of danger, and the *Diadem* securely riding to her big anchors, there was nothing anybody could do but wait. Passengers submitted to persuasion and went into the shelter of the saloons, to talk in hushed tones of the swift tragedy that had shadowed them within sight of home, almost. In a corner of the music salon the colonel held in close arms a quietly weeping daughter; and now he needed no tender care himself, but seemed to have some to spare.

After awhile, word seeped in that the tugs were in sight. That brought out the people again. But Blanche Torrey remained inside. She seemed to have no interest outside.

The tugs circled around the reef; big, powerful seagoing vessels, with searchlights that blinded the eye encountering their beams. The first, and biggest, steamed alongside and hailed the *Diadem*. (Continued on page 109)

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Advice for Popular Science readers regarding safe and profitable investments. See page 6.



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Tishy

(Continued from page 108)

The wind chopped the words, but the megaphone made clear something about a man needing medical aid; and the tug skipper shouted that he would run alongside if the man could be taken quickly. So men stood by. With a crash and a grinding the tug and steamer came together. For an instant the lights flooded both decks with stronger than daylight radiance. Strong hands passed over a bundle of blankets. Uncouth shapes clambered over the rail after the bundle, and the tug sheered off to get her lines ready. Then it was that Blanche Torrey, in the salon, heard that which snatched her out of the colonel's arms and sent her on deck with signals flying in her cheeks.

"Three cheers for Tishy!" That was in Debron's voice, a bit shaky. And two hundred seamen, and five hundred passengers, gave tongue. A crowd followed the bundle of blankets, carried along to the doctor's quarters. The captain went inside. Debron too. And Debron sketched the story, of searching for and finding Tishy exhausted, so far to leeward that the boat could make no headway back. Of sighting the lights of the tugs, and of being picked up out of a sinking boat at last.

"The little chap's pretty badly frozen, sir," said Debron. "Plucky little devil!"

"All right. Go and look after the towline and stand by to get your anchor. Tell the third mate to look out aft." And as Debron left, with a peg of the doctor's whiskey still stinging his palate, the captain found a slim, trembling girl trying to thrust past him to the surgery.

"Can't go in there, miss."

"Oh, but I'm a good nurse, captain. Please, doctor!"

The doctor knew enough about the Torreys to be sure that Blanche was a good nurse. Tishy would need a good nurse before he regained his state of normal entirety and well-being. He nodded, and the captain gave way.

It was a battered, bruised, sorely frozen Tishy that at last opened his eyes to see who possessed the caressing hand that so eased his agonies. The pained eyes closed again after one swift gleam of happy recognition. If Tishy heard any of the many voices that murmured inquiries near by, he gave no sign. When Debron called him "Tishy," Tishy's eyes opened for an instant and smiled. There was something of homage bestowed in the way Debron uttered that "Tishy" now. It sounded like the hall mark of fellowship.

Besides, his other hand, the one least badly injured, was held in the warm grasp of tender fingers that in themselves eradicated any trace of bitterness left.

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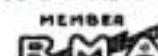
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MURRAY

Bare Hands

(Continued from page 39)

ing iron, the charcoal should be made at a high temperature, when it will become an excellent reducing agent."

Williams looked up from where he was working on a bellows.

"You know, Thornton," he grinned. "I thought my encyclopedia went down with the yawl, but it didn't."

Thornton paid no attention to Williams's attempt at humor. He was deeply pleased to think that Parker should have proffered any information. It would not have surprised him if his partner had utterly refused to aid at all. But the few days that had passed made Parker feel a little less optimistic about being rescued by a passing ship. He had endeavored to plan some sort of signal that might be erected, but his mind had conceived of nothing save such contrivances as would have to be constructed in a fully equipped factory, and he was discouraged accordingly. Furthermore, while he had made fun of the rabbit hunt and of the suits that Oomak had made, he had been very pleasantly surprised when he was at last fully dressed once more. His suit did not look as if it had come from his tailor, it is true, but it was very comfortable and warm. That very fact made him less nervous, less irritable, and consequently less sarcastic. Furthermore, his mind was an encyclopedia of technical information, and he could no more help giving it out when anyone admitted a lack of knowledge than he could help breathing.

BUT whatever the reasons for Parker's change of attitude, Thornton was pleased. He had no wish to see their friendship stretched to the breaking point.

"But how about your lime?" asked Parker.

"What the deuce do you want lime for?" asked Williams.

"It's essential," replied Parker. "It is needed to combine with the gangue of the ore and the ash of the fuel a lime silicate or slag of such a composition that it will melt and float on the molten iron, and so make it possible to draw off the impurities. In addition, it is needed for the desulphurizing reaction—let me see. I think the formula is—ah, yes, it is $FeS + CaO = Fe + CaS + CO$. In other words, its duty is to 'flux' the gangue and ash and wash out the sulphur."

"Holy smoke," muttered Williams. "Does all that mean anything, Thornton?"

"It does," replied the engineer solemnly. "It means that we ought to have limestone, but if we can't find it we may be able to do something anyway."

"IF YOUR smelter works you may," admitted Parker. "But the iron will contain all sorts of impurities, and its sulphur content may make it worthless."

"Not entirely worthless," corrected Thornton. "We can make some use of it, regardless of impurities. Of course, limestone would help."

Parker laughed and a touch of his sarcasm returned.

"Yes," he admitted. "It might help—a little."

But they found no limestone, and so were forced to go ahead without it. It took two days to prepare enough charcoal and to carry enough magnetite to fill the furnace. Oomak looked on, meantime, in wonder, unable to understand what all the activity was about.

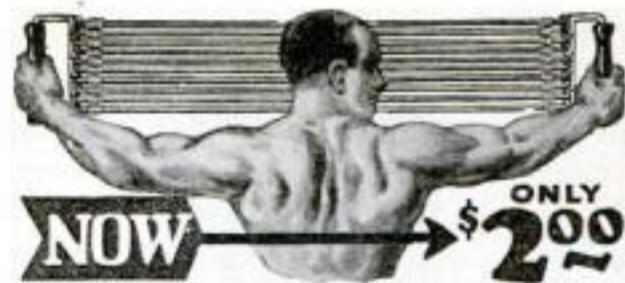
"Now what do we do?" asked Kelly when the supplies were assembled. "And how does the bloomin' thing work?"

"You see that depression in the bottom, don't you?" asked Thornton.

"Yep."

"Well, that's the hearth. We fill the furnace up with alternate layers of charcoal and magnetite. Then we set the

(Continued on page 111)



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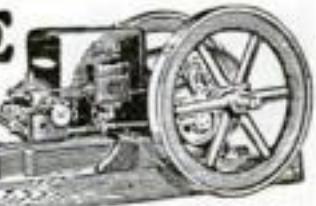
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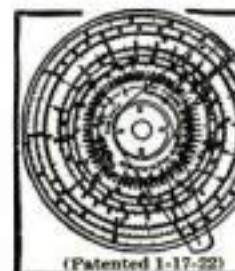
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Bare Hands

(Continued from page 110)

charcoal on fire and pump our bellows as fast as we can to create a strong draft. The charcoal separates the iron from the ore and it melts and runs down to the hearth. Other things melt and run down, too, but they are lighter than the iron and so float on it, and we let them run off through the upper one of those two holes. The lower hole is at the level of the hearth, and that will be kept plugged until the molten iron has collected. Then the plug will be removed to let the iron run out. I've made a place for it to run in the sand. Then these holes in the sand are molds. The iron will flow into them and will cool and solidify in those shapes I have worked out."

"What are they?"

"The first is a large hammer," replied Thornton. "The second is a smaller hammer, and the third is a rough axe blade. The fourth is an adze."

"What kind of iron will you get?" asked Williams.

"THAT is the question," jeered Parker. "You may not get any. On the other hand, you may get stuff with so many impurities in it that it will be worthless. That is probably what will happen. Your furnace is crude, your air pressure is limited, and you have no accurate method of assaying your ore or of measuring anything else. The various grades of iron and steel depend upon the percentage of carbon they contain. If you should get iron with less than three tenths of one percent—which is impossible—it would be malleable iron, and carbon would have to be put in it before it would become hard enough to be useful for edged tools. If you should get metal with from three tenths of one percent to two and two tenths percent of carbon—which, because your furnace is so small is conceivable but not likely—it would be steel, and that would be ideal. If, however, the metal contains more carbon than this latter amount it is cast iron, and as such will be more or less useless. Unless, of course," he sneered, "you can erect a Bessemer converter."

"Or a puddling furnace," added Thornton. "That's simple enough, and we could remove the excess carbon, and make steel or malleable iron."

Parker snorted.

"You presuppose," he argued, "that your metal will be largely free of other impurities, and that's impossible."

"Then are we all ready to go?" asked Kelly.

"ALL set," nodded Thornton. "You and Williams bust up the ore, while I get the kindling ready." He busied himself with a pile of sticks. "Now put in some charcoal—that's the stuff. Now ore. Now charcoal." He paused while they dumped the materials in. "Now more ore. That's it. She's full and we're ready."

He took a burning brand from their camp fire, thrust it through the cinder notch, and saw the kindling catch fire. It burned up slowly, and he began to pump two of the bellows—one with each hand.

"Get busy," he shouted, "and work your bellows. The experiment is on."

Parker stood idly by. He merely watched as the others labored. The bellows thumped up and down and the furnace grew hotter and hotter. Flames shot out the top, and the perspiring group pumped like mad. For half an hour they worked the rabbit skins up and down, and finally Thornton, who crouched near the cinder notch, saw a glowing residue reach the opening and slowly break over the edge.

"Pump!" he shouted. "Pump!"

He paused to take off his rabbit skin coat, and went to work again with renewed vigor.

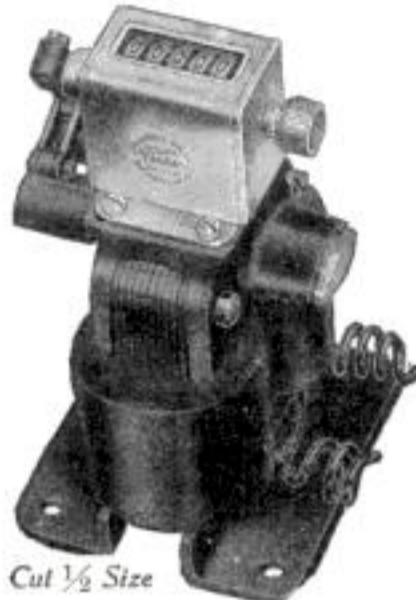
"More charcoal and (Continued on page 112)

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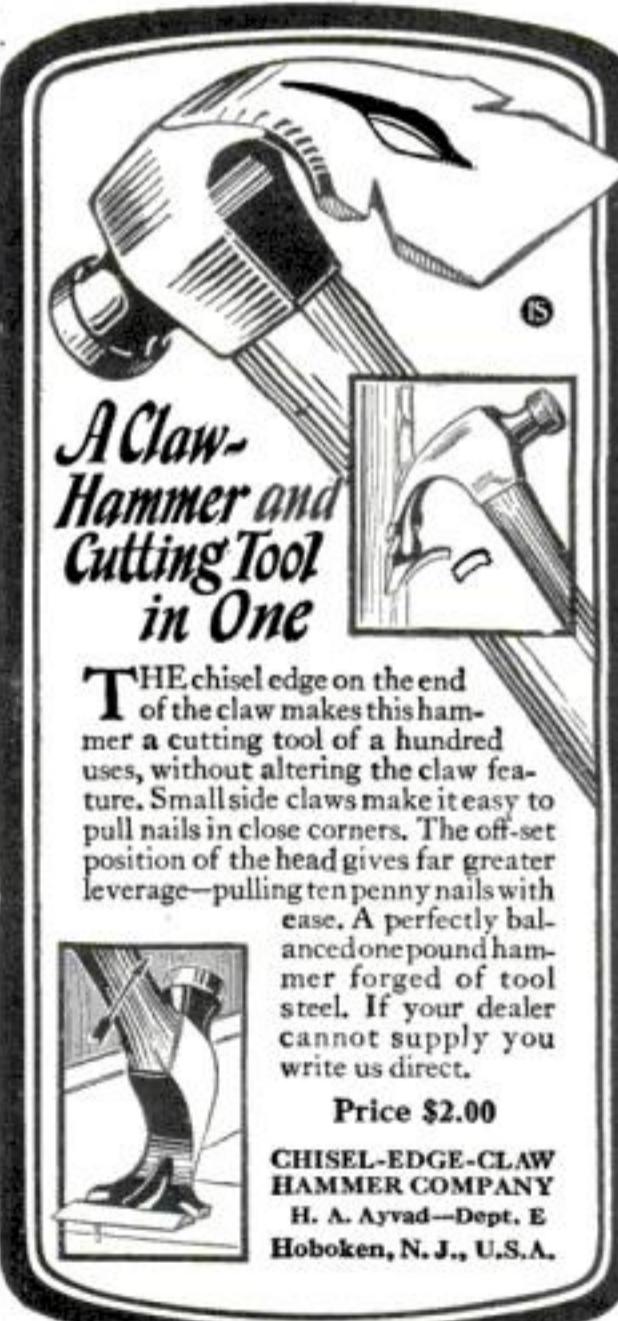
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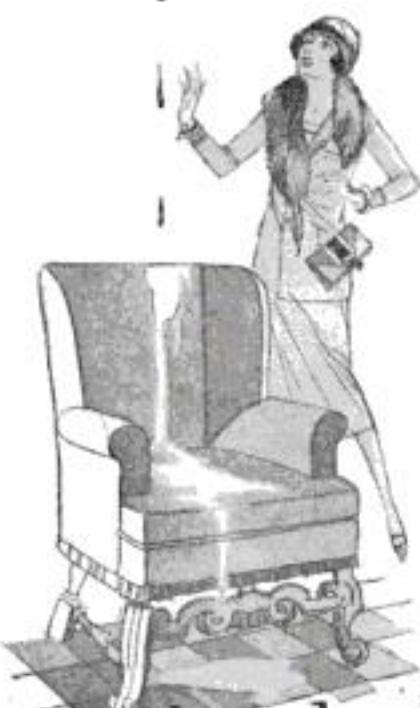
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Bare Hands

(Continued from page 111)

ore in the top," he shouted, and Kelly leaped to his feet to perform the task.

The gangue flowed out in an increasing stream, collecting in a depression in the sand. Finally Thornton leaped to his feet, seized a green willow stick he had prepared, and broke the clay stopper that plugged the hole below the cinder notch. The molten metal trickled through the cracked stopper, and he poked again. The bit of clay fell away, and a glowing stream of metal flowed forth. Thornton watched it feverishly. It flowed slowly down the track in the sand—the track that he had made to lead it to the crude molds. The hammer head formed, and slowly cooled. The second hammer head formed and sizzled, spattering out of the hole.

"The sand was too wet in your mold," explained Parker, disparagingly.

The axe and the adze glowed brightly, and slowly the bright light left them. Thornton looked back and saw the last of the iron trickling slowly out of the hole in the base of the furnace. In a moment it was followed by the gangue that now had sunk below the level of the cinder notch.

"WELL," said Thornton, taking a long breath. "That's done."

"Yes," scoffed Parker, who had stood by idly watching all this. "But it remains to be seen what you have secured. It may be worthless, you know."

Thornton did not reply, but dug the hammer head out of the sand with his stick.

"I'll put it in the water," offered Kelly.

"No, no," objected Thornton. "I want to see, if I can, what we have."

He took a stick and thrust it into the hole that led through the hammer head. The wood flared up and he withdrew it, but presently he forced another in and the cast metal—rough and misshapen though it was—was now a crude hammer. He drove the handle more firmly into place, and swung the hammer heavily against a smooth boulder.

It clanged, and Thornton held its dented face up for Parker to examine. The dent caused by the blow was noticeable, even to a less careful eye than Parker's, but he examined it closely. Obviously, he was surprised.

"Now put it in the fire and heat it," he ordered. "Get it red hot."

THORNTON built the flame about it, and watched it as it turned red once more.

"Bring some water," ordered Parker, keenly interested now. Oomak shuffled off with a shallow bark container he had made, bringing it back brimming full. Thornton watched the glowing metal, and finally drew it from the fire. He lifted it with two sticks and dropped it into the water. Steam rose in a great cloud and the water boiled. Slowly it died down, and Thornton upset the container on the ground. The hammer head lay steaming on the sand.

"Try it again," said Parker.

Thornton inserted another handle and swung once more. His blow was harder, but the mark on the face of the metal was smaller. Parker looked at it carefully and laughed.

"What is it?" asked Thornton excitedly.

"It's steel!" cried Parker. "Steel! Now maybe we can—."

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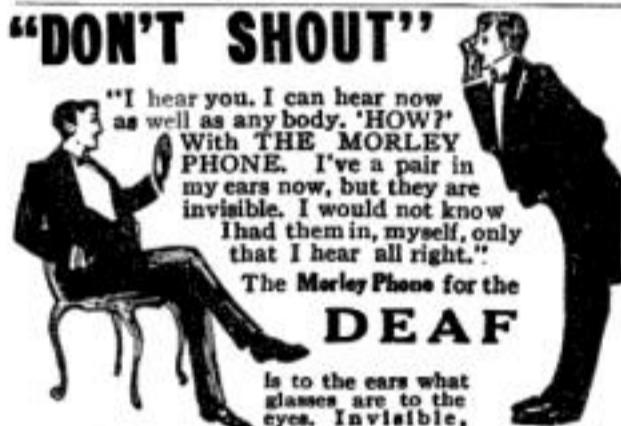
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Glenn Curtiss

(Continued from page 24)

Government test flight in September, 1908. His name is perpetuated in the Government flyingground, Selfridge Field, at Mount Clemens, Michigan, near his native town.

"At Professor Bell's home," relates Mr. Curtiss, "we discussed aviation from every possible—and impossible—angle. Each of us had his own idea. We had copies, now, of the Wright patent, showing how they controlled their plane against tipping over sideways by warping the wing structure. Of course, we could not use that, but we believed there were other ways of controlling the plane, which would not infringe on the Wright patents.

"We had full reports, too, of the experiments with gliders made by Octave Chanute and Israel Ludlow in this country and by the German, Lilienthal, who had been killed while trying to fly a glider from a mountainside. Some of us thought the biplane was the thing; Professor Bell stuck doggedly to his tetrahedral kite. We had some exciting discussions, but we were a harmonious group, and that included Mrs. Bell, who was extremely interested in what we were trying to do."

ON THE first of October Captain Tom Baldwin was giving an exhibition flight with a dirigible at St. John, New Brunswick, and the whole party went down to see it. Then and there it was decided to form the Aerial Experiment Association, which Mrs. Bell agreed to finance with an initial gift of \$25,000.

I have the original draft of the articles of agreement of the A. E. A. before me as I write. In it Professor Bell agrees to give the benefit of his ideas and assistance in carrying out the ideas of Glenn Curtiss, F. W. Baldwin, J. A. D. McCurdy and Lieutenant T. Selfridge, and they in turn agree to give Professor Bell the benefit of their advice and assistance in carrying out his own ideas of aerial locomotion, "and all working together individually and con-jointly in pursuance of their common aim, 'to get into the air,' by the construction of a practical aerodrome driven by its own motive power and carrying a man."

The Association was to last for one year. Each member was to retain all rights in his individual inventions, developed "con-jointly." Professor Bell was to put his laboratory at Baddeck at the Association's disposal, which was to be the headquarters until January 1, 1908, when some place in the United States should be selected. And one of the members was to be appointed Director of Experiments. The document was duly signed by all in the presence of the United States Consul at St. John.

UNDER this agreement, Glenn H. Curtiss was unanimously chosen as Director of Experiments and his workshop at Hammondsport, N. Y., as the United States headquarters of the Aerial Experiment Association. For a while the group continued (Continued on page 114)

today— The Dividing Line

*between the antiquated
and the modern home
is automatic oil heat*

YOU don't care what other people do, of course—but haven't you noticed that more and more of your friends are putting in oil heat? Haven't you noticed what a favorite topic of conversation it has become at bridge and dinner tables—and how enthusiastic women are about it?

Naturally it's the women who appreciate such improvements most, for they know—only too well—the never ending drudgery of shoveling coal and ashes; the inconvenience and discomfort of constantly changing temperatures; the ravages of dust, soot and smoke.

Of course, no woman really minds firing a furnace—when it can't be helped. But now that nearly all progressive people are putting in oil heat—and now that a liberal budget plan has made the perfected NOKOL so easy to install—is there any valid reason why any man of moderate means shouldn't enjoy this carefree luxurious, automatic oil heat; why his wife and home shouldn't be on the right side of "the dividing line?"

The elimination of noise is only one of the many advantages offered by the new silent NOKOL. New improvements with as nearly perfect combustion as engineers ever dared hope for; a degree of cleanliness never dreamed of before; a total absence of soot, smoke or smell of oil; a remarkable low-cost operation—often lower than hard coal.

Whether your home is large or small, there's a NOKOL of just the right capacity to give you the most efficient and economical heat, for NOKOL is made in eight different sizes. And it can be installed in a few hours time—right in your present heating plant, with practically no interruption of service. Mail the coupon for interesting booklet on oil heat—free.

NEW *Silent*
NO COAL
NOKOI
REG. U. S. PAT. OFF.
AUTOMATIC OIL HEATING FOR HOMES

FREE — NEW BOOK

AMERICAN NOKOL COMPANY

Dept. 29, 4158 Schubert Ave., Chicago

Please send me your new book on OIL HEAT.

Name.....

Address.....

City.....

State.....



Time to teach your unruly hair its place!

Let's Go!

All day your hair will lie down now... Try this popular dressing—free

No matter where you go there's one thing you don't have to worry about, today.

And that's your hair.

Once it was straggly looking an hour after you combed it. But today!—

From Maine to California, fellows now use—**Stacomb**. Stacomb makes the wildest hair lie smoothly in place, all day long.

Let us send you, *free*, a generous sample of this hair dressing—which more fellows rely on than any other!

Your hair never looks 'gummy,' with Stacomb. Nor dry and brittle, as wetting with water makes it. Stacomb is actually beneficial—it helps to prevent dandruff.

Stacomb comes as a combing cream—in jars and tubes—and now in the popular new liquid form as well. All drug stores.

FREE OFFER *Stacomb*

Standard Laboratories, Inc.,
Dept. BC-6, 113 W. 18th Street, New York

Send me free sample of Stacomb as checked:
Original, cream form New liquid form

Name.....

Address.....



as well as the many other features of the wonderful Motor that thrilled the world in 1926 by its remarkable speed and power. You will want to know especially about "The Pilot"—a NEW device that steers your boat in any course you choose—straight or curved, without attention from anyone. Leaves you free to cast, or troll or rest. The New—

LOCKWOOD
FORMERLY
BOAT MOTOR

also offers you many other advantages—improvements in Power, in Speed, in Ease of Starting, in Stopping, in Convenience and Durability. Find out all about them before you choose any Motor. Get the facts now.

WRITE FOR FREE FOLDER

Just out—See how Lockwood is blazing the way by advanced engineering methods backed by 23 years of marine engine building experience. (24)

LOCKWOOD
MOTOR COMPANY
717 Jackson St. Jackson, Mich.

Glenn Curtiss

(Continued from page 113)

to experiment at Baddeck with tetrahedral kites and with aerial propellers on boats, and then Curtiss went back to Hammondsport to prepare for the continuance of the experiment. He was "sold" on mechanical flight by this time, but was still making dirigibles.

Not long after Curtiss' return to Hammondsport, Augustus Post, Secretary of the Aero Club of America, was in his office when a telegram came from Professor Bell. "Start building," it read. "The boys will be down next week."

"That was like Professor Bell," smiles Curtiss reminiscently. "We hadn't decided what to build, or how to build it, but he wanted something built right away! Incidentally, he could not build anything himself. I never saw a man less handy with tools. The simplest operation, even driving a screw with a screw driver, stumped him. But he had very concrete ideas about the way he wanted things done and a wonderful way of getting his ideas across to the man who had the mechanical skill to carry them out. He never 'bossed,' never scolded, never criticized, but somehow he kept other people on their toes all the time. He was a wonderful man."

CONTEMPLATING the telegram from Professor Bell and discussing it with Mr. Post, Glenn Curtiss decided that the way to get quick action was to build a glider, which could be constructed in a week and would provide occupation while the motor-driven plane was being built. So when McCurdy, "Casey" Baldwin and Lieutenant Selfridge joined him, there was a glider all ready, and all four of them practiced gliding from the hillsides of Lake Keuka.

Selfridge was given the honor of approving the first plane. It was a biplane, with the wing structure covered with red silk, so it was named the *Red Wing*. Each member of the Association contributed ideas, but this was to be Selfridge's machine, and acceptance or rejection of the suggestions of the others rested solely with him. The *Red Wing* was finished, motor installed, everything ready for the "jump-off" early in 1908, but the icy north winds did not let up sufficiently to make the experiment until March 12th when, on a still but intensely cold day, the *Red Wing* made its first and last flight.

IT HAD been agreed to try it out on the first favorable day, whether Selfridge was there or not. When the day arrived, Selfridge had been called away on business, so it fell to "Casey" Baldwin to take the tiller, while the others started the engine by giving the propeller a whirl.

"There was a real thrill," said Curtiss. "The *Red Wing* was equipped with skids, as were the early Wright machines. It skated over the ice of Lake Keuka while we held our breaths, wondering if it would rise into the air. At last it did! We saw an airplane fly!"

The *Red Wing* rose nearly eight feet

into the air, traveled a distance of three hundred and eighteen feet, eleven inches, and then crashed, landing on one wing tip and wrecking the whole machine.

"It was about what we had expected," said Mr. Curtiss, "but we were jubilant. We knew now that we could build another machine that would fly higher and longer. We had spent seven weeks building the *Red Wing* and it had taken twenty minutes to smash it, but we had achieved a great thing—the first public flight of a heavier-than-air flying machine."

"CASEY" Baldwin took charge of the design of the next machine, the *White Wing*. The ice had broken up before it was finished, and its tests had to be made on an old race track near Hammondsport known as "Stony Brook Farm." There were crashes and disappointments galore, some short jumps, one or two flights almost as high and as far as the *Red Wing* had gone, rebuilding, repairing, changing the design, consulting with Professor Bell, who had come down from Nova Scotia to join his youngsters, and a tremendous disappointment when, after discarding the expensive silk for cheaper cotton for the wing covering, the machine refused to rise at all. This was puzzling, until Professor Bell pointed out that the porous cotton did not offer sufficient air resistance; so the wing covering was varnished, now the universal practice. On May 22, 1908, Glenn Curtiss took his seat in the *White Wing* and really flew!

One thousand and seventeen feet in nineteen seconds was the *White Wing's* record on this occasion. It rose high enough into the air to leave no doubt that it was really flying; high enough for the people of Hammondsport to see it over the race track fences. And it landed in a plowed field without damage.

"This was regarded as a remarkable flight and, naturally, I felt very much elated," said Mr. Curtiss. "There was no question, now, that we had found the right principle on which to base our further experiments. And we had proved to a skeptical world that mechanical flight was an actuality."

Now it became Curtiss' turn to take charge of the construction of the next machine, and work was started on the *June Bug*, in which Glenn Curtiss was to make, on the Fourth of July, the first previously-announced public flight ever made by any airman, and to win the Scientific American Trophy for the first flight of one kilometer or more.

In the next installment of this remarkable series, Mr. Stockbridge tells how Glenn Curtiss built and flew the *June Bug*, won the Scientific American Trophy, gave New York City its first sight of an airplane in flight and then went to France and captured new honors. This story is more than a chronicle of the career of one man; it reveals for the first time the fascinating details of the early history of aviation—facts hitherto known only to Curtiss and a few other pioneers.

New Hair in 30 Days
Days or No Cost—
—New Hair in 30
30 Days or No Cost
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ays or No
—New Hair
30 Days or



My Contract! To Men Who Want New Hair

Why fear dandruff and falling hair—when you can easily escape the tragedy of baldness? Here's my contract to you in black and white! I positively GUARANTEE to end dandruff—stop falling hair—grow new hair in 30 days—or I'll pay every penny of cost myself!

By **ALOIS MERKE**

Founder of Famous Merke Institute, Fifth Ave., New York

NOW you can stop falling hair! Now you can save yourself from baldness! Now you can try this "no risk" way to grow new hair in 30 days!

Read My Contract!

No strings attached! No "Ifs," "Ands," "Buts" or "Maybes." No matter how thin your hair may be—no matter how fast it is falling out—no matter how many treatments you've tried without real results — my contract stands. New hair in 30 days — or the trial costs you absolutely **NOTHING!**

My Secret Method!

There's nothing "tricky" about my treatment. It's simply the result of years of research and day after day experience in treating thousands of cases of loss of hair. At the famous Merke Institute, Fifth Avenue, New York, I have proved that in most cases of baldness the hair roots are not dead but merely dormant—asleep!

Thus you are foolishly throwing away money—wasting your time—when you try to reach these dormant roots with ordinary hair tonics, oils,

massages and salves. Such measures treat only the *surface skin* and never even get to the roots, the *real source* of trouble. How could they ever possibly grow new hair?

How My Method Works

It's no use trying to make a tree grow by rubbing "growing fluid" on the bark. You must get to the roots!

And that's just why my scientific treatment is so tremendously beneficial! It penetrates below the surface of the scalp. It quickly reaches the *cause* of the trouble—the dormant, starving hair roots. It awakens them. It carries nourishment to them. No artificial hair tonics—no rubbing. Yet in a surprisingly short time—sooner than you ever imagined possible—you have a wonderful new healthy growth of hair—OR I PAY ALL COSTS OF THE TREATMENT MYSELF!

And, best of all, my system is so simple that it can be used in any home where there is electricity without the slightest discomfort, and for just a few cents a day.

PROOF!

New Life and Lustre After 8 Days

"A short time ago my hair was falling out and I was troubled with dandruff. Your wonderful treatment has put my scalp in a very healthy condition, stopped the hair from falling out and given it new life and lustre only using it eight days." R.A.H., New York.

Treatment Quickly Puts Scalp in Good Condition

"I have been partly bald for years and my hair was in such condition I believe I would have been completely bald by this time. . . . In a short time my hair stopped falling and now my scalp is in a healthy condition and new hair has started to grow." C.L.L., Beloit, Wis.

New Hair or No Cost!

Thousands claim seeming miracles for my treatment. I don't. I admit some cases of baldness are hopeless. Only remember this—these cases are so rare, and so many others have regained luxuriant hair through my method that I am willing to let you try it for 30 days—AT MY RISK!

Then if you are not absolutely delighted—say so. And I'll mail you a check immediately—refunding every cent of your money—and the treatment will have cost you nothing!

Send for Free Booklet!

Lack of space prevents me from giving you all the facts about this amazing treatment and the wonderful contract and absolute guarantee I offer you. If you will simply sign and mail the coupon below I'll send you—absolutely free—a remarkably interesting booklet—telling in detail the whole story about this remarkable system which is growing new hair for thousands all over the country. In addition it tells all about my iron-clad contract which enables you to take the treatment without a penny's risk. No obligation. Sign and mail the coupon NOW! Allied Merke Institutes, Inc., Dept. 174, 512 Fifth Avenue, New York City.

ALLIED MERKE INSTITUTES, Inc.,
Dept. 174, 512 Fifth Avenue, New York City.

Please send me—without cost or obligation—in plain wrapper, a copy of your book, "The New Way to Grow Hair," describing the Merke System.

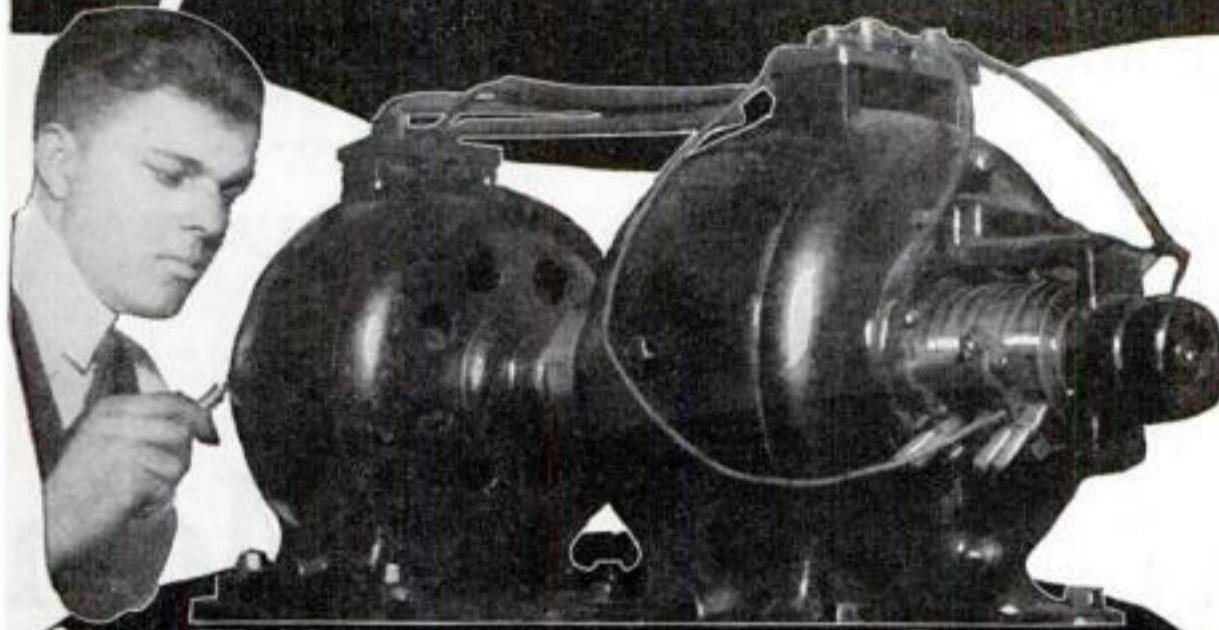
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(State whether Mr., Mrs. or Miss)

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City..... State.....

Money Making Opportunities for Readers of Popular Science Monthly

Learn Electricity by Actual Work...



in 3 Months at COYNE

Learn to Earn \$65 to \$200 a Week

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Yes, 3 months at the Great School of Coyne, located in Chicago, The Electrical Center of the World, will make you an Electrical Expert capable of commanding big pay. The whole world of electricity is open to the practical man, the man who has had actual experience with electrical apparatus. Coyne gives you a practical training on the greatest outlay of electrical apparatus of any institution in the World; everything from door bells to power plants.

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We don't make you a mere "paper" electrician. We train you by practice on our mammoth outlay of actual equipment. We train you in house-wiring by having you do it exactly as it is done outside—not just by reading about it. The same applies to armature winding, power plant operating, motor installations, automotive work and hundreds of electrical jobs. That's why we can train you to become a Master Electrical Expert.

No Books—No Lessons—No Classes

You Do Actual Work

The Coyne practical course includes no books, printed lessons or useless theory. We train you to work with your head and hands on the same kind of electrical apparatus as you will find "out in the field." Age, lack of experience or education is no

drawback. Our students range from 16 to 60 years of age. Coyne gives you Free, a Life Scholarship which enables you to return at any time for instruction on new apparatus which we are continually adding to our course. We assist you to a position after graduation. Free Radio Course included.

Earn While You Learn!

We help students to secure jobs to earn a good part of their living expenses while studying

Send Coupon Now

Send coupon today for big Free Book and full details of our special offer of Free Railroad Fare. Act now.

H. C. Lewis, Pres.

Founded 1899

COYNE

ELECTRICAL SCHOOL

1300-1310 West Harrison St., Dept. 47-73
CHICAGO, ILL.

Free R.R. Fare

IF YOU ENROLL NOW

H. C. Lewis, Pres.

COYNE ELECTRICAL SCHOOL, Dept. 47-73,
1300-1310 W. Harrison St., Chicago, Ill.

Dear Mr. Lewis: Please send me free your big catalog and your special offer of free railroad fare.

Name.....

Address.....

How Robert Hubbard Is Getting Ahead in the World

Every month hundreds of people tell us how they have used advertisements in POPULAR SCIENCE MONTHLY as stepping stones to success. This month Robert Hubbard wins the first prize for the best letter telling how success has been won through the use of opportunities offered by advertisers in POPULAR SCIENCE MONTHLY. Mr. Hubbard says:

Contest Editor:

The advertisement that interests me most in the "Money Making Opportunities" section of POPULAR SCIENCE MONTHLY for January is that of the American School.

Two years ago I was working in a big department store at \$18 a week with little hope of promotion. The oldest and best sales people on the same floor with me received \$25 a week.

For two years I studied hard at night and finished my course in business training which included the art of writing advertisements for big businesses. I am now doing the advertising of two of the biggest department stores in the city. My salary runs from \$60 to \$125 a week and I am not closely confined.

My advancement with big boost in earning capacity are due to my ambition and the training given me by the American School.

Courses are offered in electricity, drafting, automobile mechanics, business and high school branches, and any young man or woman who desires to rise above his environment can find what he needs in the American School.

ROBERT HUBBARD, Little Rock, Ark.

From \$18 a week to \$80 is the story told by E. J. Bennett whose letter wins the second prize.

Contest Editor:

I always had a talent for drawing and wanted to be a commercial artist, but there were seven other children in the family and money was scarce. However, I managed to finish high school by selling papers.

As I had to work, I took the first job offered me, a place in a grocery at \$18.00 per week. A long ways from a commercial artist wasn't it? But I hadn't given up hope. One day, some literature from Meyer Both Company fell into my hands. I read it eagerly and sent for more about the work I was interested in. I enrolled as a student. It took me nearly two years to finish the course as I kept my grocery job but, I earned, by my drawings during the course, enough to pay for it seven times. Today I'm making over \$4,000 per year and I have not reached my limit yet by any means. Is it any wonder I'm a Meyer Both "booster"?

E. J. BENNETT, Parkersburg, W. Va.

You will see in reading these letters that both Mr. Hubbard and Mr. Bennett not only have greatly increased their salary but they are doing the work they most want to do.

You will find on pages 116 to 143 an opportunity to study any business, trade or profession you may have a natural liking for. Decide (*Continued on page 117*)

How Robert Hubbard Is Getting Ahead in the World

(Continued from page 116)

what you would like most to do and then send the coupons or write to the advertisers in the Money Making Opportunities Section who can help fit you for the job you want.

\$25 in CASH PRIZES

For the best letter of 170 words or less answering the question—

"What advertisement in the 'Money Making Opportunities Section' interests you most—and why?"

we will pay on May 10th the following—

CASH PRIZES

First Prize	\$10.00
Second Prize	5.00
Third Prize	3.00
Seven Prizes of \$1.00 Each	7.00

First read every advertisement in the Money Making Opportunities Section on pages 116 to 143. Pick out the one that interests you most and then write a letter—not exceeding 170 words—telling us why you find the advertisement you have selected the most interesting.

Entries for the contest will close on April 1st. The prize winners and their letters will be published in the June issue of POPULAR SCIENCE MONTHLY.

*Address your letter to
Contest Editor*

MONEY MAKING OPPORTUNITIES
POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York

PRIZE WINNERS in the February Contest

FIRST PRIZE \$10.00

Robert Hubbard, Little Rock, Ark.
(American School)

SECOND PRIZE \$5.00

E. J. Bennett, Parkersburg, W. Va.
(Meyer Both Company)

THIRD PRIZE \$3.00

E. O. Greene, Gallipolis, Ohio
(International Corres. Schools)

PRIZE WINNERS who receive \$1.00
each for their letters:

Harriet Paine, California, Pa.
(David B. Clarkson Co.)

Melvin L. Hopla, Keyport, N. J.
(National School of Cartooning)

T. W. Davey, North Vancouver, B. C.,
Canada
(Brooks Boat Co.)

D. C. Marshall, Manhattan, Kansas
(Aero Shop)

Oliver O. Fuller, Lincoln, Ill.
(North American Institute)

Frank G. Davis, Springfield, Ohio
(David B. Clarkson Co.)

Isabel Ebel, Brooklyn, N. Y.
(Fireside Industries)



J. A. STRANSKY

Here's My Guarantee to Car Owners...

FREE GASOLINE OFFER

I will send you samples of the Stransky Vaporizer to test in your car. If you are not convinced that it will save you 1/4 to 1/2 of the gasoline you now use; that it will end carbon and spark trouble caused by excessive fuel feeding; that it will increase the power of your engine; that it is absolutely harmless, and that it will satisfy and delight you in every way—

If it does not live up to the above—if it is unsatisfactory for any reason whatsoever—you may return it and I will refund every penny of the low

price you paid for it. What is more, I will pay a cash forfeit of one-half dollar if the test is unsuccessful, to compensate for the time you spend in testing it. This offer has already been accepted by over a million car owners.

L. G. STRANSKY, Vice-Pres.
J. A. Stransky Mfg. Co.
Pukwana, So. Dakota
Resources Over
\$500,000

g. stransky

Save $\frac{1}{4}$ to $\frac{1}{2}$! Your Gasoline!

Or This Daring Trial is FREE

I HEREBY HURL THIS CHALLENGE AT EVERY CAR OWNER IN THE WORLD. ACCEPT MY OFFER TO TEST THIS AMAZING DEVICE ON YOUR CAR—THE TEST TO BE FREE IF UNSUCCESSFUL IN YOUR OPINION. READ BELOW HOW IT WORKS. LEARN HOW YOU CAN MAKE MONEY FULL OR SPARE TIME AS MY REPRESENTATIVE. THEN MAIL COUPON BEFORE OFFER EXPIRES. MANY EARN

\$75 TO \$200 IN A WEEK!

HOW would you like to run your car 1,300 miles without buying any gasoline at all? That is what J. R. Wood, of St. Louis, reports. "My Oldsmobile sedan used to average only 17 miles per gallon," he writes, "but since installing the Stransky Vaporizer it has averaged better than 30 miles per gallon for over 3,000 miles."

More evidence. Out of thousands of unsolicited testimonials we have reports of increased gasoline mileage as follows: Ford 20 to 60 miles on a gallon, Star 25 to 31, Chevrolet 30 to 52, Dodge 20 to 40, Hudson 19 to 21, Overland 19 to 31, Nash 19 to 22, Hupmobile 32 to 37, Buick 17 to 32, Studebaker 23 to 27, Cadillac 12 to 18—and so on. The list is endless.

And still more evidence! Out of the over-a-million users, we have many reports from those who have had the Stransky Vaporizer on their cars for as long as three to eight years. Every day they give it the most searching test in actual operation. And still they continue to report increased mileage, more power, less carbon and engine trouble.

How It Works

J. A. Stransky, former candidate for Governor of South Dakota, is the inventor of this amazing device. It is a simple little piece of metal not much larger than a dollar coin. Anybody can install it in a few minutes. It is automatic and self-regulating. It



operates on the sound and well-recognized principle of multiplying the vapor power of the gasoline.

Official tests have shown that most car owners waste 20 to 30% of their gas through improper combustion. But if your saving is less than 25% you need not pay a red cent for the device.

Ends Carbon Troubles

But saving gas isn't the only service performed by this device, according to car owners. They say it has ended carbon and spark plug troubles, "barking" and "spitting," makes the engine start quicker and increases the power. And it provides a third service—a convenient way to remove already-formed carbon, employing the same method used in cleaning out the famous Diesel engine.

How This Test Is FREE

Don't send a penny or accept anything until you find out how this device works. The coupon below will bring you full details that answer every question. Mail it now and test this opportunity to cut down the expense of running your car.

If you are interested in making money on the side, or as a full-time proposition, we have a wonderful plan for you. Over 5,000 men have become distributors for this wonderful (and low priced) device. Last year they earned \$300,000 in profits. No selling experience is required. Mail the coupon now without obligation.

\$48 in 3 Hours

My gas bill has been cut in half. I have removed every particle of carbon from my engine. Since I installed it my engine runs as good as new, starts easier and quicker. I went out Saturday about three hours and secured 16 orders.

J. A. Williams.

The STRANSKY VAPORIZER *Saves Gasoline*

J. A. STRANSKY MFG. CO.,
Dept. D-730.
Resources Over \$500,000

Pukwana, So. Dak.
Established 10 Years

J. A. Stransky Mfg. Co.,
Dept. D-730, Pukwana, South Dakota

Yes, I want to learn full details of your offer to test this way to save me gasoline, and carbon troubles, and increase power. Also send me details of your money-making plan for distributors. This request does not obligate me in any way.

Name.....

Address.....

City.....

State.....

Opportunities for Readers in Quick Action Advertising

Advertising Services

ADVERTISE in 24 metropolitan dailies, 24 words, \$15.00. Helpful Guide listing 1000 publications, 4c stamps. Wade Company, Baltimore Bldg., Chicago.

24 WORDS, 151 rural weeklies, \$6.00. Ad-Meyer, 4112P Hartford, St. Louis, Mo.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

EFFECTIVE letters and advertisements for honest propositions. Edwin Brown, Box 83, Phoenix, Arizona.

NATIONALLY KNOWN firms use my ideas. To save money write fully before selling your new product. Vernon Baker, Elyria, Ohio.

Authors and Manuscripts

SS\$ FOR Ideas. Photoplay Plots revised, criticized, copyrighted, marketed. Send for free booklet. Universal Scenario Company, 238 Security Bldg., Santa Monica & Western Ave., Hollywood, Calif.

SONG Poem Writers—Send for proposition. Ray Hibbler, D10, 2104 N. Keystone Ave., Chicago.

SONG Poems Wanted. Write, Ambrose Thomas, Box 327, Norwalk, Ohio.

I WANT song poems. Casper Nathan, J-3544 No. Racine, Chicago.

FREE. "Song Writers' Guide." D22-1239 Elm, Green Bay, Wis.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

Automobiles and Accessories

DELIVERY bodies for Ford Model T, Chassis with Inclosed cab, suitable for Contractors, Grocermen and Farmers. Three styles. Price \$42.00. Write Daniel Zimmerman, Craigville, Indiana.

NEW and used auto parts. Save 25-50%. Motors, Rear ends, Radiators, Wheels, Generators, Starters, Carburetors, \$5.00 up. Complete Tops \$15.00. Gears, Axles, Bearings, Nickel Spring Bumpers. Brightman Auto Parts Co., 321 Windsor Ave., Hartford, Conn.

Aviation

THE American School of Aviation announces a new correspondence course in mechanics of aviation. A thorough training in practical aeronautics. American School of Aviation, Dept. 6741, 3601 Michigan Ave., Chicago, Illinois.

"**BOYS**, send dime for a 12-inch mounted propeller and circular telling how you can get a three-foot model aeroplane free. Aero Shop, 3050 Hurbut Ave., Detroit, Mich."

BIGGEST, Best Catalog Model Airplanes, Parts, Supplies; 5c postpaid. Ideal Company, 163½ Spring Street, New York.

DICTIONARY OF AVIATION. \$3.90 postpaid.—Languages Publishing Company, 8 West 40th Street, New York.

Bending Machines

THE FAMOUS Hossfeld "Wrenchless" Universal Iron Bender is the last word in bending machines. Bends both Pipe and Bars to most any conceivable shape. Bends Eyes, "U's", Angles, Rings, Colls, etc. Accurately bends anything from a small nail up to a 1½" pipe cold. Instantly adjusted without a wrench. Thousands in use. Write for Circular and prices. Hossfeld Mfg. Co., Winona, Minn.

Blacksmith

BE A master machine blacksmith and expert tool maker and dresser with Collard Tempering Charts. Price \$1.00. Valuable samples free. W. M. Toy, Sidney, Ohio.

Boats and Launches

COMMENCE now, build your own boat for this season's use. 55 Models 9' to 40'. Send 25¢ today for complete catalog. Brooks Boat Co., Inc., Salt Street, Saginaw West Side, Mich.

Business Opportunities

LEARN the collection business. Good income; quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

BECOME a Foot Correctionist. A New Profession not medical nor chiropody. All the trade you can attend to; many are making \$3,000 to \$10,000 yearly, easy terms for training by mail, no further capital needed or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 10 Back Bay, Boston, Mass.

WE Start you in business, furnishing everything. Men and women, opportunity to earn \$35 to \$100 weekly operating Ragsdale's original "New System Specialty Candy Factories" anywhere: wholesale or retail. Big commercial candy book free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

Rates 30 Cents a Word. A 10% discount is allowed on all contracts for six consecutive insertions. Advertisements intended for the June, 1927, issue should be received by April 5th.

Business Opportunities

PATENTS procured: Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington, D. C., or 41-Z Park Row, New York.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

"\$50.00 WEEKLY mailing form letters. We furnish everything. Samples and particulars 10c. Whitney Co. Station C, Cincinnati, Ohio."

SIGNS and Showcards easily painted with Letter Patterns. Large variety of styles and sizes. Write for free samples. John Rahn, D 2120 Neva Ave., Chicago.

MODERN Mail Order Methods. A new book that tells how to operate a mail order business successfully. Write for free circular. Patrick-Mahoney Co., P. O. Box 931, Schenectady, N. Y.

MINIATURE die-casting machines \$50.00. Byrd—318 Reed, Erie, Pa.

MANUFACTURE and sell latest Novelties, Toys, Mail order and agent's Specialties. Free list reliable patterns, processes, commercial information. Manufacturer's Bureau, R-2, 1129 East 31st, Kansas City, Mo.

GET money quick and easy manufacturing. We tell you how. New idea. Full particulars free. Write quick. Colic Bureau, Box 265, Winnipeg, Canada.

ADVERTISE—In 275 country newspapers; 28 words, \$10.00. Keator, Hartford Bldg., Chicago.

"**\$20 STARTS** clean, simple home work, mail-order business. Circular free. B. M. Smith, Box 369, Morristown, New Jersey.

USED correspondence school courses sold on repurchase basis. Also rented and exchanged. Money-back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

INVENTIONS commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 183 Enright, St. Louis, Mo.

MIRRORS resilvered at home costs less. 5 cents per square foot; you charge 75 cents. Immense profits. Plating auto parts, reflectors, tableware, stoves. Refinishing metalware etc. Outfits furnished. Details FREE. Write Sprinkle, Plater, 94, Marion, Indiana.

15c PUTS your name on mailing list year. Receive offers, magazines, from wholesale supply houses everywhere. Kentucky Agency, Covington, Kentucky.

"**SCHEMER,**" Alliance, Ohio, 36p monthly, prints Schemes, Tips, Formulas; subscriber reports \$25,000 from three; another \$10,000 from one. Try it! Year, \$1.00; 3 months, 30c.

IF YOU are tired of working for others, and are looking for something to do during your spare time, write us. Service Box 531, Lake Forest, Illinois.

OPERATE money-making mail-order business in spare time. Write for free particulars, Triangle Mail Order Service, 600 Blue Island Ave., R33, Chicago.

BIG BUSINESS producer. A dollar bottle of our famous Vanilla and one dollar set of Labohme Pearls both for One Dollar. You make 50¢ on every combination. Big flash, best quality goods, and everybody buys. Mystol Co., Dept. A5, Glens Falls, N. Y.

OPERATE Chewing Gum Machines. Large profits. Small Capital. Particulars free. Robbins Company, 23 Dodworth St., Brooklyn, N. Y.

INCREASE your income—"Selected Opportunities" listing 24 business plans, two formula charts, \$1.00. Robert Smeriglio, Box 884-F, Stamford, Conn.

DAILY PROFIT opportunities presented trading with stock privileges; small capital sufficient. Write Paul Kaye, 149 Broadway, New York.

THAXLY Formulas, Processes, Trade-Secrets, produce perfect products. Catalog, special circulars free. C. Thaxly Co., Washington, D. C.

MAKE money with little "Mail Order Business." Send stamped self-addressed envelope for particulars. Earle Murdell, 3006 7th Ave., Los Angeles, Calif.

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TO THE man who has a Home Workshop and likes to work with tools. Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of useful articles for the home. The following are a few of the blue prints available: No. 15, Workshop Bench, No. 17, Cedar and Mahogany Chest, No. 41, One-tube Radio Set, No. 42, Radio Receiver with three stages of amplification, No. 43, Four-tube Radio Receiver, 44 and 45, Model Pirate Ship, 46 and 47, Spanish Galleon, 48, Model Sailing Yacht, No. 50, Airplane model, 51, 52 and 53, Clipper Ship, 54 and 55, Five-tube Radio set. Send 25¢ for each blue print you wish to Popular Science Monthly, 242 Fourth Avenue, New York, N. Y.

Capital Raising

CAPITAL Supplied for Worthy Projects; Commission basis; reorganizing; refinancing; corporations and mergers formed. 1131 Suite, 11 Broadway, New York.

Capital Raising

BUSINESS ENTERPRISES Needing Capital. Will finance amounts up to \$100,000.00. Corporations preferred. G. Dewitt Talmadge, 4732 North Racine Ave., Chicago, Ill.

CAPITAL Raising Campaigns Prepared. Commission Basis. Morris Advertising Agency, 3608 Warren St., Philadelphia.

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SEND 10¢, silver or stamps, for sample package 20 finest quality mild cigarettes. Large tin Special smoking tobacco, 10¢. French Tobacco Company, Dept. 25, Statesville, North Carolina.

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ELECTRIC Fun! Seventy stunts, 110 volts, \$1. Teutting, Campbell, Calif.

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STOCKS—Bonds, Domestic—Foreign, bought—sold. Dealers in all marketable securities. Frank G. Everett & Co., 20 Broad St., New York.

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For Boys

LOOK! 2000 theatre tickets and 150 feet movie film \$2.00 postpaid. Northern Theatre Supply, Duluth, Minnesota.

For Men and Women

DETECTIVES—Work home or travel. Experience unnecessary. Write, George Wagner, former Government Detective, 2190 Broadway, N. Y.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

What Spell Does This Strange Book cast over its readers?

Examine it free for 5 days. If it does not give color, charm and magnetism to your personality, return it within the 5-day period—and the examination will have cost you nothing.

YOU have had books that entertained you—books that interested you—books, even, that amazed you. But never a book like this!

Here is a book that seems to cast a spell over every person who turns its pages!

Almost every page radiates brilliant ideas. Every paragraph guides you unerringly in developing a new, dominant, powerful, magnetic personality.

A copy of this singular book was left lying on a hotel table for a few weeks. Nearly 400 people saw the book—read a few pages—and then *sent for a copy*.

In another case a physician placed a copy on the table in his waiting room. More than 200 of his patients saw the book—read part of it—and then *ordered copies for themselves*.

You can sway and control others! You can command success. You can influence people to do things you want them to do. *This strange magnetic book shows how!*

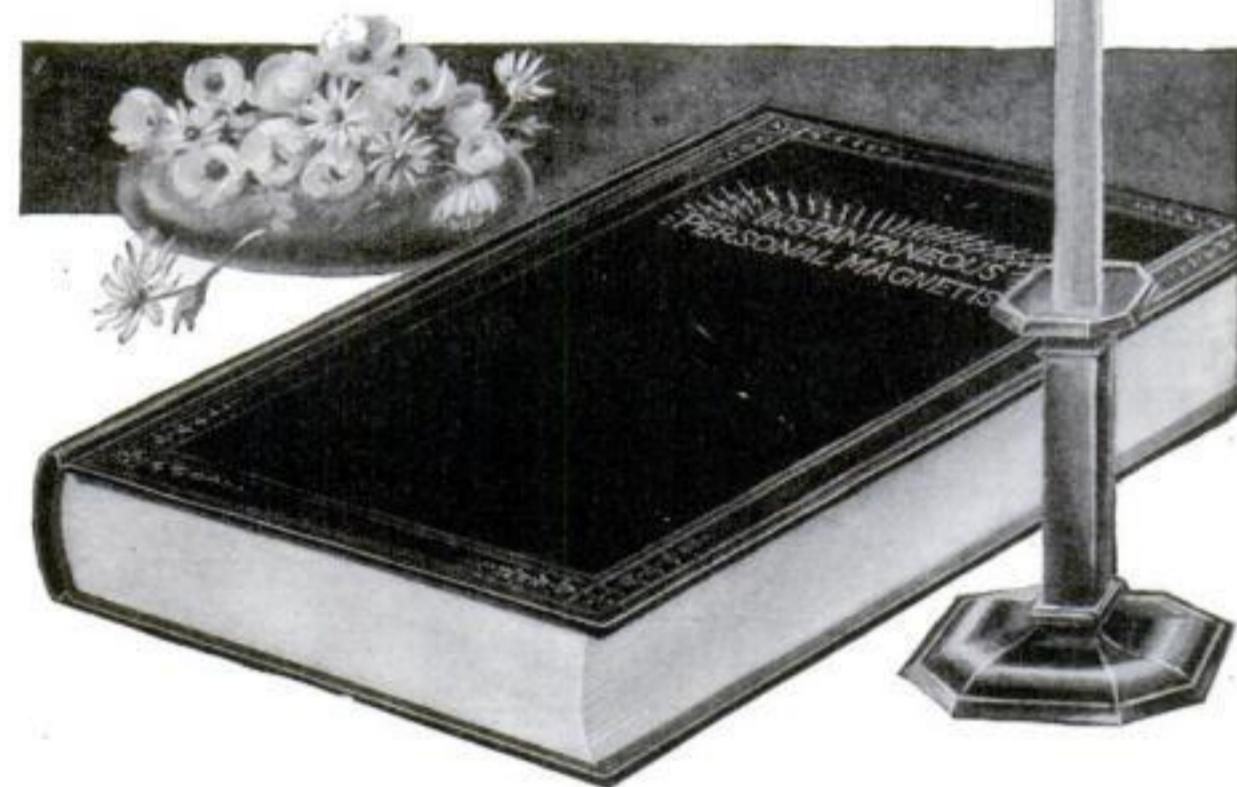
Once for the Wealthy Only —Now Within the Reach of All!

"Instantaneous Personal Magnetism," just completed after fifty years of research and study, is now off the press and ready for you. Edmund Shaftesbury, founder of this interesting system, devoted a lifetime to it. Such men and women as Queen Victoria, Cardinal Gibbons, Lord Beaconsfield, Gladstone, Henry Ward Beecher were among his friends and pupils.

"Instantaneous Personal Magnetism" tells how to draw people to you at once, irresistibly—how to be popular everywhere, in any society—how to be a magnet of human attraction, popular and well-liked wherever you go!

It not only tells exactly how to accomplish these things—it tells how to accomplish many of them without delay—*instantly!* How to develop your mental, passionate and personal magnetism!

Shaftesbury's amazing science of magnetic



control was at first confined to the use of those wealthy few who could pay from \$200.00 to \$500.00 for the scientist's private instruction.

With the publication of "Instantaneous Personal Magnetism," Shaftesbury's complete method of magnetic development is within the reach of everyone. Everything that he taught on the cultivation of personal magnetism is in this one authentic book. It will show you how to awaken your creative energies and set free your great thought-force and magnetic self!

—and watch yourself become more and more successful, popular.

Give verve, color, magnetism to your personality—and see what a difference it makes in your life! The drab, colorless personality is a handicap; the irresistible, dynamic, compelling personality cannot fail to be recognized and respected in every society and under all circumstances—in your business, your profession.

Instantaneous Personal Magnetism—Now Yours!

The principles that Edmund Shaftesbury taught to those famous men and women—and for which many paid as high as \$500—have been brought up to date and the new, revised edition can now be yours—for little more than the cost of an ordinary volume! Imagine it! Edmund Shaftesbury's whole astounding principle of magnetic control to apply to your own personality and use in your daily contacts with people!

Mail Coupon Today For 5 Days' FREE PROOF

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If you are not thrilled and inspired by this amazing book, just return it within the 5-day period, and the examination will have cost you nothing. Otherwise keep it as your own and send only \$3 in full payment. Clip and mail this coupon, NOW, before you forget, for the most magnetic book you ever saw! Ralston University Press, Dept. 14-H, Meriden, Conn.

RALSTON UNIVERSITY PRESS,
Dept. 14-H, Meriden, Conn.

You may send me "Instantaneous Personal Magnetism" for a 5-days' free examination in my own home. I will be the judge. Within the 5-day period I will either remit the special low price of \$3 in full payment or return it without cost or obligation.

Name.....

Address.....

City..... State.....

What Personal Magnetism Is

Personal Magnetism is not necessarily inborn. It can be cultivated, fostered, until it becomes a natural part of you. Your eyes, hands, lips, voice, bearing—all radiate personality of an individual kind. All lend themselves to the one great fundamental quality known as *Personal Magnetism*.

Strange Effect on Readers

Readers of this book quickly become masters of a singular power to attract others—to influence men and women around them. Not by force—not by loud argument. But rather by some subtle, insinuating power that sways men's minds and emotions. They are able to play on people's feelings just as a skilled violinist plays upon a violin.

Folks are rarely the same after reading this book. Their manner changes. The tone of their voice, the expression in their eyes—yes, even their actual features seem to change—seem to grow more cultured, more refined.

Release this dormant magnetism within you

What Grateful Readers Say

"I am indebted to Shaftesbury for all that I am in this world."

"Made me a success financially, socially and morally."

"I would not give up what Shaftesbury has taught me for \$100,000."

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SREGOR: 92 Middle St., Manchester, N. H. Any formula wanted, 25c.

"SKIN PEELING LOTION"—formula, Non-Acid. Original Cosmetic Surgeon's Process. Complete Formula \$10.00. Sample enough to peel face and neck, \$1.50. Eugene Roy, Consulting Chemist, 7 Hillside St., Haverhill, Mass.

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INVENTORS: Get this pamphlet—"What to Invent." No theory or guess work, but things actually asked for by manufacturers. Sent prepaid for only \$1.00. Inventors' Syndicate, 23 Paladium Bldg., St. Louis, Mo.

I AM in touch with hundreds of moneyed men and manufacturers who wish to buy good inventions. Hartley, 38 Court St., Bangor, Maine.

"INVENTIONS developed to practical basis—non-infringing devices designed—Basic claims suggested.—A. Papini, Leonia, N. J."

INVENTORS' Universal Educator—contains 900 mechanical movements; 50 perpetual motions. Tells how to obtain and sell patents. Suggests new ideas. Explains how to select your attorney and avoid patent sharks. Special Price, \$1.00 postpaid. Albert E. Dietrich, 681 Ouray Bldg., Washington, D. C.

INVENTORS assisted financially to secure patents. Equitable Investment Company, Washington.

INVENTIONS developed. Experimental and Model Work. A. H. Bowers Machine Works, Woodbridge, N. J.

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TO the man who likes to work with tools, Popular Science Monthly offers the opportunity to purchase blueprints giving details of the construction of useful articles for the home. The following are a few of the blueprints available: No. 1, Sewing Table, No. 5, Kitchen Cabinet, No. 13, Tea Wagon, No. 15, Workshop Bench, No. 17, Cedar and Mahogany Chest, No. 43, Four Tube Radio Receiver, 44 and 45, Model Pirate Ship, 46 and 47, Spanish Galleon, 48, Model Sailing Yacht. Send 25¢ for each blueprint that you wish to Popular Science Monthly, 242 Fourth Avenue, New York, N. Y.

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EARN \$25 weekly, spare time, writing for newspapers, magazines. Experience unnecessary. Details free. Press Syndicate, 971, St. Louis, Mo.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

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MEN, get Forest Ranger job, \$125-\$300 mo. and home furnished; permanent; hunt, fish, trap. For details, write Norton, 224 McMann Bldg., Denver, Colo.

MEN—Get U. S. Mail or Forest Ranger jobs, \$125-\$225 monthly; steady; experience unnecessary; details free. Y. Bradford, 112 Bergen, Jersey City, N. J.

SECRET SERVICE Badge Free. Be a Detective, travel, big pay. Send \$2 for year's membership to Continental Secret Service System, Box 81K, Waukegan, Illinois.

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MEN wanting forest ranger, railway mail clerk and other govt. positions. Write for particulars. Mokane, A-30, Denver, Colo.

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RELIABLE INFORMATION any subject. Formulas, processes. Prompt, accurate service. Charges moderate. Correspondence invited. Alan Cook, Box 952, Los Angeles, Calif.

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WHY NOT spend Spring, Summer, Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth \$1 to \$7. Simple outdoor work with my instructions, illustrations, price-list. Send 10c for Illustrated Prospectus. Sinclair, Dealer in Insects, Dept. 7, Box 1424, San Diego, Calif.

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TELL time by the stars! United States Government takes time from the stars. You can do the same. "Startime," an extremely ingenious and scientifically correct instrument, gives you exact time. Most attractive novelty ever offered. Extremely fascinating! Durable made of aluminum, in fine leatherette case. Sent postpaid on receipt of \$1. Startime Mfg. Co., Garden City, N. Y.

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WILL buy approved invention. Write W. L. Kendig, 416 N. Duke Street, Lancaster, Pa.

INVENTIONS commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 183 Enright, St. Louis, Mo.

VERNON BAKER. See "Advertising."

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YOUR chemical problem solved and working formula or process furnished for \$5.00. Write me. W. Stedman Richards, Industrial Chemist, Box 2402, Boston, Mass.

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99% GUARANTEED Mailing Lists. Agents, Business Firms, Individuals, Professions, for every need. Guaranteed reliable and accurately compiled. Catalogue and price list on request. National Mailing List Co., 845 Broad St., Newark, N. J.

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VERNON BAKER. See "Advertising."

Mail Order Methods

MAIL dealers, \$1.00 brings invaluable book. Save money by knowing how. Fedra, 7933-S Kingston, Chicago.

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MODEL, Experimental and Light Machine work. Accurate, prompt service. Lowest prices. Southern Instrument Works, 1210 Dallas Ave., Houston, Texas.

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"SPECIAL machine builders, tool and die makers, Inventor's models, production work of all kinds. Dept. J, Quality Hardware & Machine Co., Ravenswood and Thorndale Avenues, Chicago, Ill."

SHIP MODEL FITTINGS: Send stamp for list. A. J. Fisher, 1005 Etowah Ave., Royal Oak, Mich.

SPECIAL MACHINERY or parts, Dies, Tools, Metal Specialties, Model special gears, stock gears and Model Supplies. Send 5c for Catalogue. The Pierce Model Works, Tinley Park, Ill.

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WORKING models built. Drawings prepared free. Let our designing and engineering departments and 27 years' experience assist you with your invention. Lowest prices. Hohmeier Mfg. Co., 1385 E. 17th St., Cleveland, Ohio.

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SAXOPHONISTS—Clarinetists—Cornetists—Trombonists—get "Free Pointers." Virtuoso Music School, 36, Buffalo, N. Y.

A NEW kind of violin catalogue. Artistic—as the unique merit of Collingwood Violins demands. Artistic repairing. Write today. Drew Collingwood, 5102 Woodland Ave., Philadelphia, Pa.

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Optical Goods

ARTIFICIAL eyes. Booklet free. Denver Optic, 508 Quincy, Denver, Colorado.

ARTIFICIAL EYES fitted by mail \$5. Free booklet explains. Ramsdell Optical Company, Moline, Illinois.

Patent Attorneys

PATENTS—Time counts in applying for patents. Don't risk delay in protecting your idea. Send sketch or model for instructions or write for FREE book, "How to Obtain a Patent" and "Record of Invention" form. No charge for information on how to proceed. Communications strictly confidential. Prompt, careful, efficient service. Clarence A. O'Brien, Registered Patent Attorney, Security Bank Building (directly across street from Patent Office), Washington, D. C. (See page 129).

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A Twin Service for Ambitious Men



O. C. MILLER
Director Extension Work

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THOUSAND Hammermill letterheads, four dollars. Multigraphing. Mayray Corporation, Monmouth, Illinois.

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ENVELOPE Printing cheap: \$00. \$1.00 prepaid. Harvey Teeple, Decatur, Indiana.

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LETTER HEADS, envelopes, etc. Jean McLane, 1215 Russell Ave., Bethlehem, Pa.

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WANTED: Men who want to make money to co-operate with a National Radio Service Organization. No limit to earnings. No selling. Co-operative Radio Doctors, 131 Essex St., Salem, Mass.

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LAND free if planted to bananas. Bananas bear a full crop the second year. \$5.00 monthly will plant five acres, which should pay \$1,500 profit annually. Reliable Companies will cultivate and market your bananas for you. Bananas ripen every day and you get your check every 90 days. For particulars address Jantha Plantation Co., Empire Building, Block 308, Pittsburgh, Pa.

Salesmen and Agents Wanted

AGENTS—Clever invention: Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Bldg., New York.

GET our free sample case, toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F, St. Louis, Missouri.

AGENTS, \$60-\$200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A, N. Clark, Chicago.

BANKRUPT and Rummage Sales. Make \$50.00 daily. We start you, furnishing everything. Distributors Dept. 34, 609 Division, Chicago.

\$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outlets furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

AGENTS—Best seller: Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 304 Amazon Building, Philadelphia, Pennsylvania.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

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A BUSINESS of your own—Making Sparkling Glass Name and Number Plates, Checkerboards, Signs, Big Book and Sample free. E. Palmer, 513, Wooster, Ohio.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 467, Amsterdam, N. Y.

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FORMULAS for making your own guaranteed products. Investment Small. No Machinery Needed. 300 to 1200% profit! Stamp Brings Interesting Descriptive Literature for Fly Killing Spray, Delicious Summer Drinks, Best Metal Polishing Cloth, Hair Marcelle Liquid, No-Water Hand Soap, Lightning Battery Charging Liquid, Mendit, Fabric Patching Liquid; Amazon Tire Repair, Washing Compounds; Compatibl Wood-stone, Wonder Gloss; Wizard Polish; Pure Food; Toilet, Medical, Household Specialties, All Lines. State what interests most. Miller, Chemist, 1706 Jettony, Tampa, Florida.

POLMET Polishing Cloth cleans all metal. Sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

AGENTS—new plan, makes it easy to earn \$50.00 to \$100.00 weekly, selling shirts direct to wearer. No capital or experience needed. Represent a real manufacturer. Write now for free samples. Madison Company, 566 Broadway, New York.

AGENTS! Big money monogramming by transfer method. Catalog showing over 50 styles and particulars free. Motorists' Accessories Co., Mansfield, Ohio.

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AGENTS—Our gold-eyed needle cases are wonderful sellers; immense profits; \$50 to \$300 weekly; proof and particulars free; sample outfit, 15c. Patsy Needle Co., Somerville, Mass.

AGENTS: Make \$500.00 Monthly. Pay daily. No investment. Rhinestone initial buckles and novelties sell easy everywhere. Exclusive territory. Chaton Novelty Co., 606 Blue Island, Chicago.

SELLING like blazes! Eleven piece toilet goods assortment at \$2.25 with two piece carving set free to your customers. 100% profit. Davis Products Co., Dept. 57, 1321 Carroll, Chicago.

TO SELL Ray-O-Lite cigar and gas lighters. Big earnings. Sample 50c. Rapid Mfg. Co., 799-X, Broadway, New York.

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SELL Radium Water Generators. Entirely new fast seller, repeat orders sure. Permanent income. Ask Why to-day. Radium Refinery, 2209 Broadway, Oakland, Calif.

DON'T SELL for others. Employ agents yourself. Make your own products. Toilet articles, household specialties, etc. 500% profit. We furnish everything and show you how. Valuable booklet free. Write at once. National Scientific Laboratories, 1946 W. Broad, Richmond, Va.

AGENTS, both sexes, we manufacture and control new household article. Fast seller. Big profits. Exclusive territory. Write now, Connally, 123 Liberty St., N. Y.

CLEVER sales-talkers—not canvassers—wanted. Sell contracts, not goods. Get into the houses with a new plan and give the housewife something she has long been looking for. Extras, too, in addition to main contract which runs \$5 to \$100 per house. Can travel if desired; good winter or summer. No hard work. Write for full particulars. Fordwood Finishing Company, New Milford, Conn.

AGENTS—Stamping names on Pocket Key Protectors; sample check with your name and address, 25c. Stamping Outfits, Emblem Checks, Check Fobs, Name Plates. Hart Mfg. Co., Desk 2-305 Degraw St., Brooklyn, N. Y.

AGENTS, Salesmen, Crewmen—You'll have the Devil's own time finding a better seller than "Zippo." Splendid profit on snappy 50c "Go-Getter" repeat article that sells on a ten-second demonstration. Works while you watch it. Demonstrates value while others waste time making claims. New development. Greatest scientific triumph of the age. It's the berries. Write immediately for complete proposition. Karam-Smith Company, 904 Boaz Street, Fort Wayne, Indiana.

SELL Beauty Aids, New Plan, sample and particulars 25c. Jeanne, 244 Sta. A, San Antonio, Texas.

AMAZING Gas Saver. Every Auto. 1 free to introduce. Vapor moisture. Doubles Mileage. Critchlow, A-142, Wheaton, Ill.

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GET Harrison's New free Shirt Outfit. Big samples. Fine portfolios. Made like custom shirts, but sell quick at amazingly low prices. No experience or capital necessary. Write for territory and free equipment. Harrison Bros., Drawer 302, 133-141 West 21st, New York City.

FREE Large wholesale specialty catalog, showing best sellers from all parts of the world. Speris Co., Lesueur Center, Minn.

AGENTS—Big Seller—\$20 Daily Easy selling Taylor Caps—made-to-measure—every man buys—some want 2 or 3 caps. Samples free to agents. Write quick for fast money making proposition. Taylor Cap Manufacturers, Dept. W-33, Cincinnati, Ohio.

AMAZING large cash commissions introducing beautiful \$3.95 and \$4.95 fit-to-measure guaranteed shoes. Actual samples furnished. Write for your territory. Style Arch Shoe Co., Dept. Q-107, Cincinnati, Ohio.

AGENTS \$240 month and auto to travel in. Bonus besides. Introduce new line guaranteed hosiery for men, women, children. 126 styles, colors. Beats store prices. Guaranteed to wear 7 months or new hose free. Finest Line Silk Hosiery you ever saw. High class proposition. New sales plan. No experience needed. Credit given. Spare time satisfactory. Write for samples. Wilkitt Hosiery Co., Dept. 1232, Greenfield, Ohio.

AGENT makes \$57 a day driving nails in tire! Amazing discovery heals all punctures—one tire was punctured 857 times without a leak. Send for free Sample Offer. O. S. Nelson, C-3180 Logan Bldg., Mitchell, S. Dak.

TAILORING salesmen who must make \$5,000 annually. We offer the wonder line of the age. Samples yard-and-a-third long—the kind regular tailors show. Absolute satisfaction or money back guarantee. Every garment individually cut, bench tailored. Finest fabrics. No charge for extra sizes or special styles. Suits \$29.50 to \$47.50. Highest commissions. Big bonus to producers. Beautiful Spring line ready. Write today and include three business references. Hamilton Tailoring Co., Fourth & Central, Cincinnati, Ohio.

Salesmen and Agents Wanted

AGENTS: Ride in new auto. Show samples and collect \$17.50 cash daily in advance. Bonus besides. Finest new line hosiery—129 styles and colors. Guaranteed 7 months. Priced to sell fast and repeat. Permanent business. Big profits. Steady income. Spare time satisfactory. No experience needed. Start on credit. Write quick for samples. Betterknit Textile Co., Dept. 83, Greenfield, Ohio.

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MAN between 25 and 65 to act as manufacturer's agent. No investment necessary. A man with selling experience or willing to learn, who can command respect and who is willing to work, will find this a permanent business, with an income of from \$175 to \$425 a month. Write to Harry O. Judy, Box 966, Dayton, Ohio.

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AGENTS \$60 week. New tool chest, 8 tools in one. Handy. Fits hip pocket. Fine leather case. Newest thing out. Going big. Write quick. Novelty Cutlery Co., Chest 632, Canton, Ohio.

AGENTS. I'll pay you \$240 a month taking orders for Stuart's guaranteed household specialties. Hand-some selling outfit furnished. Write quick. Stuart & Co., Dept. 432, Newark, New York.

\$10 TO \$20 DAILY easily earned selling shoes for the largest direct to wearer concern in the world at saving of \$2 to \$3 pair. Some good protected territory still open. Doublewear Shoe Co., Minneapolis, Minn.

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SALESMEN big commission, to sell all wool, hand tailored, made to measure suits and overcoats \$23.50. Large line sample swatches easy to sell. Sample outfit free. Helm Tailoring Company, Dept. 7, 616 W. Baltimore Street, Baltimore, Md.

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"REDSKIN" FountainPen—sample, 49c. "Hawkins," 215 Las Animas, Colorado Springs, Colo.

THAXLY Formulas, Processes, Trade-Secrets, produce perfect products. Catalog, special circulars free. C. Thaxly Co., Washington, D. C.

AGENTS: Keep in touch with best selling propositions. Send name and address today for next three big issues of How to Sell magazine FREE. Sam E. Spalding, Mt. Morris, Ill.

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FREE Outfit. Pay daily. Whirlwind seller for women, men. Colored Slickers \$2.95. It's Easy. Superbuilt. Box 453, Chicago.

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EARN \$80 weekly and bonus selling men's hosiery, shirts, underwear and pajamas. Big repeat business. Full or part time. No investment necessary. Sample outfit free. Write at once. Nustile Fabrics Corporation, Dept. 4-4, Philadelphia, Pa.

SALESMAN or Saleswoman with car, in unoccupied territory. Real businesslike connection. Good steadily increasing income, from repeat sales of unique standard value goods, consumed continuously in every home. Long established manufacturer. Opportunity to supervise others. Wells Process Co., Cleveland, Ohio.

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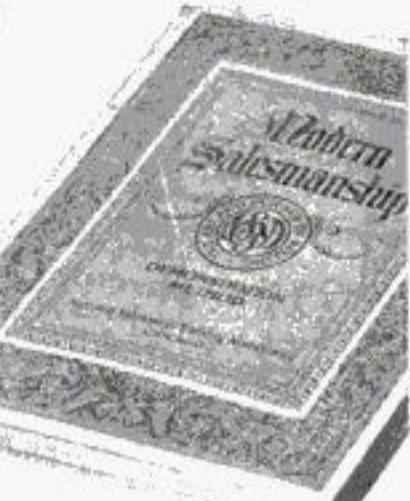
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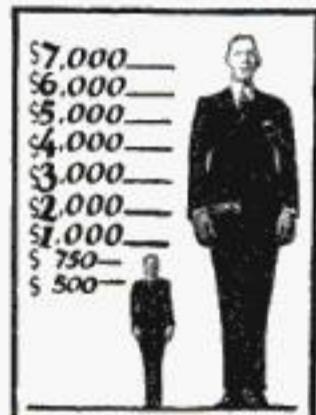


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20 VARIETIES unused free. Postage 2c. P. S. Miami Stamp Co., Toledo, O.

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STORY ideas wanted for photoplays and magazines. Big demand. Accepted in any form for revision, development and submission to markets. Send manuscript for free criticism. Booklet mailed on request. Universal Scenario Company, 402 Security Bldg., Santa Monica Blvd. and Western Ave., Hollywood, Calif.

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Advice for POPULAR SCIENCE readers regarding safe and profitable investments. See Page 6.

Men Who Blast for Liquid Gold

(Continued from page 27)

eighteen miles away, while inhabitants of Coffeyville, thirty-five miles distant, said they felt a slight shock.

"Nitroglycerin explosions can occur in curious ways. Friction is one of the greatest dangers, and we take every precaution to guard against it."

"Suppose, for instance, a little of the fluid should spill in a well-shooter's car. It slips through close places like quicksilver, and might penetrate to the spring leaves, to a bolt, or to some other part where there is friction. You might be driving along an open road some day when, without warning, that drop of nitroglycerin would go off. It would detonate the whole load. Nobody would ever know what happened."

"Escaped nitroglycerin has lasting qualities, too. A man and his son were killed one day by a blast while digging a ditch near Hemlock, Pennsylvania. The thing remained a mystery until it was learned that they had dug into an old acid ravine from a nitroglycerin plant, from which a quantity of the fluid had escaped twelve years before."

"OF COURSE, an experienced well-shooter doesn't take any unnecessary chances. When he loads nitroglycerin into his auto, he loads it so it won't leak. Look, here's how it's carried."

Hill turned and lifted the wooden lid in the rear of his car. Beneath the lid there was a rubber sheet. He drew that back, showing a series of separate compartments, fifteen in all, in each of which was a square tin can.

"These cans hold ten quarts each. I never fill them tight, because when nitroglycerin gets warm it expands and might force the corks out or cause too much pressure. Pressure is dangerous. Jolts are transmitted too easily when the liquid is under pressure. In fact, I let it cool off in the cans and form enough of a vacuum to pull the sides in. It's safer that way."

"But that's just part of it. Every can is carried in one of these rubber boots." From one of the compartments he drew out a square rubber container. There was a piece of absorbent waste in the bottom, acting as padding and as a blotter. "The rubber boots," Hill explained, "rest on a rubber sheet. There's a copper pan under that, and between the copper and the car itself there's a sheet of asbestos.

"ALL this is a protection not only against leakage but against heat and friction as well. The way it's loaded, this car could probably come safely through a wreck, provided none of the cans was crushed."

"Methods of handling nitroglycerin have undergone some amazing changes since the early days. The railroads used to haul it in refrigerator cars, and demanded that it be frozen before they'd take it. Nowadays we believe it's more dangerous than as a liquid."

This theory was advanced in explanation of an

(Continued on page 126)

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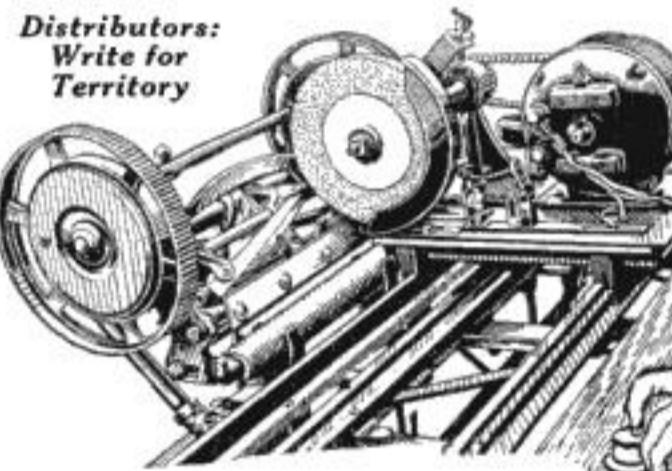
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Men Who Blast for Liquid Gold

(Continued from page 125)

explosion near Tulsa, Okla., not long ago. Several miles from town there are several storage magazines, chiefly in ravines where natural barriers protect the surrounding country. A shooter had gone to one of the magazines to check up the stock. It was a bitter cold day. A short while after the man entered the magazine, there was a shattering explosion.

One explanation of the tragedy was that the nitroglycerin had been frozen. It was surmised that two cans had stuck together, and that in separating them the shooter had broken an ice crystal or jolted the treacherous contents of one of the cans.

The thawing of frozen nitroglycerin is a task a well-shooter frequently faces, and a ticklish one, too. The nitro must be warmed just enough, and not too much. The vapor from hot water is often used, for the process cannot be hastened. Fire is taboo. So is live steam.

BUT there are curiously contradictory properties in this powerful explosive. While it must be thawed without approaching a blaze, it has been known actually to burn without serious consequences!

"One day a magazine near Tulsa caught fire," Hill recalls. "It was discovered by a new employee who didn't know what to do, got frightened, raced into Tulsa, and notified the office. Some experienced men were rushed to the spot, and they found the nitroglycerin still burning! It hadn't gotten hot enough to explode, yet. They smothered the blaze with sand and that was all there was to it. The men were heroes, of course, for it was a terrifically hazardous thing to do."

Such daring is not always in evidence, where nitroglycerin is concerned. A number of years ago, a truckload which was passing through Bradford, Pennsylvania, overturned, somehow. Miraculously there was no explosion.

"But the driver's arm was caught and held fast by the truck," Hill relates. "The people who wanted to rescue him were afraid of setting off the explosives, and losing their own lives and his. The poor fellow was held for a half hour, before they finally got him free of the wreckage."

THERE have been a good many theories about what could and could not be done safely with nitroglycerin. A half century ago several European nations forbade its manufacture as too hazardous. But Alfred Nobel, Swedish scientist, inventor of dynamite and now known chiefly as the donor of the Nobel Prizes, contended that nitroglycerin was comparatively safe, and urged its general use for industrial work. Strange experiments were made to prove its safety. For example, a bottle of nitroglycerin was thrown against a rock, without producing an explosion. And when a quantity of the fluid was spread on an anvil and struck with a hammer, each blow, it was

declared, exploded only the portion immediately under the hammer. Just how far this principle works out is apparently debatable.

"As for oil well shooting, the shooter who isn't on the job every second of the time is out of luck," says Hill. "In one case, in Kansas, the shooter lowered a leaky shell into an oil well. As it was going down, some of the nitroglycerin leaked on to the casing of the well—the casing is the pipe put into the hole as it is dug, to hold back the dirt. Well, when the second shell passed this point, it scraped, and the friction set off the escaped nitroglycerin. The explosion wrecked the whole casing."

"Another time a cave-in, three quarters of a mile down, caused an inexperienced well-shooter to make a costly miscalculation that nearly wrecked the well. And once, when a shooter at Jennings, Oklahoma, started a shell downward, it was caught by a rise of oil and gas. The shell was belched out of the hole and exploded on the derrick floor, killing the shooter."

SOMETIMES, too, the shooter must drive miles through a storm, and work at a well with lightning flashing overhead. That, in my opinion, is one of the most dangerous phases of this work. With 100 quarts of nitroglycerin in your car, you wouldn't want to share your auto seat with a bolt of lightning."

In spite of all the experience and knowledge gathered by the profession through years of handling nitroglycerin, conditions still arise to baffle experts. Some Texas fields, for instance, recently presented the puzzle of "self-firing" shells.

"When lowered into the holes," Hill explains, "the charges would go off before their scheduled time. Occasionally they could do without a firing squib entirely, and leave the shell to explode itself. The thing has baffled investigators. My theory is that some chemical or electric action in the ground starts leaks in the shells and the tin buckles, causing friction which sets off the charges."

How Do You Window-Shop?

THAT women are more interested in shop window displays containing pictures of women, and men more interested in their own sex, was the conclusion of a window display test made recently in New York City. Of the twenty pictures that received most of the pedestrian's gaze, only half were of models partly clothed. Animated figures were less successful in holding the continued gaze of passers-by than still pictures. Only five percent of all pedestrians stopped to look. The average time of inspection was eight seconds, with more men stopping than women.

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Don't Blame Your Radio Set

(Continued from page 45)

press, it appears that Congress will pass a radio bill that is a compromise arrived at by the Senate and House conferees. Embodied in it are many of the important provisions of both factions. Unless further amended, the bill will provide for a commission which will have full control of radio broadcasting for one year; after that control will be vested in the Secretary of Commerce with a commission to decide disputes and protests. An appeal to the courts is provided as a last resort.

But you, as a radio fan, cannot expect immediate relief from the present intolerable interference. Even if the bill is passed without further delay, it will take time to organize the commission, and the commission will have to make a careful and comprehensive study of the situation before taking any definite action.

But no matter what system of control is installed, there will be two grave problems that must be settled before order can be brought out of the present radio chaos. One is: How many stations shall be allowed to broadcast? The other is: Which stations shall be compelled to close down?

As a radio listener, you undoubtedly have formed some very definite opinions on these two important questions as they apply to the broadcasting stations that are received with regularity in your section of the country.

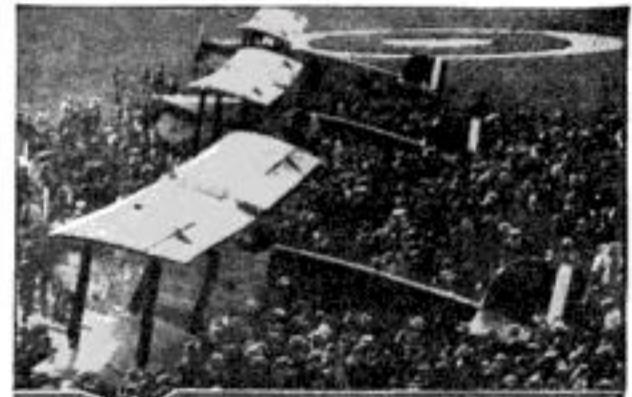
Which stations do you want to continue broadcasting? Which, in your opinion, should be shut down? If you care to write a letter to POPULAR SCIENCE MONTHLY incorporating your ideas on this important matter, we will be glad to forward them to whatever controlling agency Congress establishes.

New Publications

Romance in Science, by Prof. Bessie L. Miller. The Stratford Company. There is a Fourth Dimension in Mathematics, but that does not prove there is a Fourth Dimension in Spiritualism, and Einstein does not claim it does, this writer says. Neither does he claim that there is an actual Fourth Dimension in the physical sense that can be felt and smelt and seen. The magazine humorists are off the track, and are joking without their premise.

Wild Birds in City Parks, by Herbert Eugene Walter and Alice Hall Walter. The Macmillan Company. The book tells how to stalk and identify birds without putting salt on their tails, describes 203 species to be found in city parks, and gives all manner of tables concerning their appearance and habits.

Brains of Rats and Men, by C. Judson Herrick, Professor of Neurology, University of Chicago. The University of Chicago Press. This book reverses the usual process of tracing human faculties backward to the animals and traces them forward from animals to men, taking especially the brains of rats and men to prove that the cerebral cortex has evolved.



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Marvels of Scaffolding

(Continued from page 30)

the foundations, huge mechanical mixers preparing concrete for caissons and retaining walls, towering derricks lifting steel beams and setting them in place, and daring structural workers scampering over the beams, bolting and riveting them together. Seldom, however, do we realize the enormous task involved in clothing the steel skeleton with walls. Yet this problem, perhaps more than any other, heretofore has limited the height to which buildings could go. It has been solved at last, only after a struggle between American engineering ingenuity and the laws of gravity.

With the first true steel skyscraper, a score of years ago, there developed, almost overnight, a new race of working acrobats. Without staging, often without even a ladder, they rode the beams and columns flung around by derricks, and worked with a speed and daring which would have made our tree-climbing progenitors gasp.

BUT the veneer of brick, stone or terra cotta could not be placed so easily from inside. Speed and economy of labor required that every square inch of the building exterior must be reached easily by human hands. Staging built up from the ground, for heavy materials and many men, might serve the purpose up to a height of some six stories; but beyond that point the forest of timbers became too heavy, the cost excessive, and the hazards out of reason.

Many schemes were devised. The block and tackle was discarded early, for the hazards of rope, weight, knots, and so on, were too great. Hundreds of mechanical contrivances were built, tried and scrapped; and many accidents occurred. But finally, out of the human laboratory there merged principles and designs that brought into being our great towers of industry.

As early as 1910, the hanging scaffold demonstrated its safety. Fifty workmen, busy on a suspended platform over the great plaza of the Grand Central Terminal in New York, escaped unscathed when a terrific gas explosion went off directly beneath them, killing twelve and injuring more than a hundred men working in other locations. And by 1914 this type of scaffolding had become so reliable that the walls of the Woolworth Building were erected without the loss of a life.

TODAY the suspended scaffold is so secure that even if one or two of the wire cables should snap, the platform and its load would not fall. The planks are overlapped in such a way that if a cable gives way, they will lock together and support themselves!

The method of operating the trapeze scaffold, like the machine itself, is typically American. A number of large concerns supply "scaffold service" to builders. Each employs a force of skilled riggers, builds and rents equipment, installs, inspects and maintains it in good condition.

The time-rental basis undoubtedly

leads to economy and rapidity of erection. Perhaps the greatest economy lies in the fact that the new scaffolding can be quickly changed to a new elevation without interruption of work. With stationary scaffolding, it was necessary to move workmen and materials from the platform before its position could be changed. This meant loss of time, with a corresponding increase in cost of construction. Now, however, the hanging platform can be raised quickly with a few strokes of a lever which winds the strong steel cables on the hoisting drums. If the work requires, one end of the platform may be fixed several feet higher than the other.

A recent development which has done much to facilitate high construction is the architectural design of skyscrapers providing for a succession of steps or setbacks, beginning twenty to forty stories up, each of which serves as a working ledge from which materials may be passed on to the next ledge. By this method, there is virtually no mechanical limit to height, for the hanging scaffolding can be raised indefinitely.

BRIDGES, with their great steel and concrete arches, also have taxed the ingenuity of scaffold experts. Sometimes the bridge must span a chasm where falsework is out of the question. In Brazil, for example, a suspension bridge with a main span of 1,114 feet recently was erected without the use of any falsework whatever. By ingenious methods the main cables were employed to carry workmen and materials.

The scaffold cost may make or break the bridge builder. Not many years ago expert designers on the great Hell Gate bridge in New York fairly outdid themselves in eliminating the last unnecessary pound of steel in the structure. But they neglected the question of falsework design for the unusual type of bridge they evolved. As a result, the greatly increased cost of erection considerably more than absorbed the saving in steel.

The scaffold expert also plays an important role when high chimneys, power plant stacks or church towers are to be built. Every job offers a different problem. In the past it has been necessary often to erect staging the full height of a stack or tower, both inside and out. Here, again, the hanging platform is doing much to simplify the task. For example, a great building in New York will have a ventilating stack 375 feet high, and every square foot of its inside surface is being plastered from suspended scaffolding.

HEREFORE not a little of the cost, as well as the hazard, of scaffolding has been in its removal. Wooden staging, such as church towers and hoists have required, must be taken down slowly and carefully, beginning at the top. Considering that stagings for 400-foot church towers, and 590-foot hoist towers, have been erected, the task is a long and tedious one. Again the advantages of the new "trapeze" methods are obvious.

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Shall We Scrap the Yardstick?

(Continued from page 33)

1790 that the French National Assembly made law the metric system—invented, some say, by the Englishman, James Watt, or, as others declare, by French scientists. Rapidly it spread to other countries, until now it is the standard of a billion of the world's inhabitants.

At the International Bureau of Weights and Measures at Sevres, France, is a platinum-iridium bar, triple-locked in a subterranean vault. Three different keys are required to enter, each held by a high official; for the precious possession within, measured by two scratches on the bar, is the world's standard meter. No master financier of crookdom has ever attempted to tamper with it, but they are taking no chances.

YE甫, priceless as it is as a standard of almost inconceivable accuracy, the bar is not irreplaceable. Destroy it, and you would not have destroyed the metric system. For the meter, tangibly represented by these scratches, is defined in terms of a measurement that can never change, no matter if the earth should pucker like a dried apple or rock from its orbit—in terms of light itself. The glowing red rays of heated cadmium are more immutable even than the universe, and their wave length fixes forever the length of the world's meter.

Is this scientific yardstick wholly unfamiliar to you? You are better acquainted with the meter and its colleagues, the gram and the liter, than you suppose. Here and there, the metric system pops up with considerable frequency in your daily life.

When you prepare to tune in on a radio concert, you consult the program listed in the newspaper. There you find the station you wish to hear; opposite, its wave length is given. In meters!

Each time you spend a nickel, you are parting with exactly five grams of metal; for the U. S. Mint determines the weight of its coins by the metric system.

For yacht races, the six-meter yacht is standard. A new six-cylinder automobile is advertised as a $2\frac{1}{2}$ liter car—giving a vivid picture of the size of its cylinders' bore and stroke, through the metric unit of cubic capacity. In photography, all standard motion picture film is made exactly three and a half centimeters wide.

THOSE of us who diet—whether our aim is slimness, plumpness or just good health—are well acquainted with the calorie, heat-unit of food. Scientists speak of the calorie as the amount of heat it would take to raise one little c.c. of water one centigrade or metric degree of temperature—or nearly two of our degrees. It is a 100 percent metric unit.

Could the United States adopt the metric system without too much confusion at the start? "We could iron out all the differences in, say, a ten-year period," declare its advocates. "Other countries, too, had their periods of readjustment in adopting it. In the end the whole country benefits."

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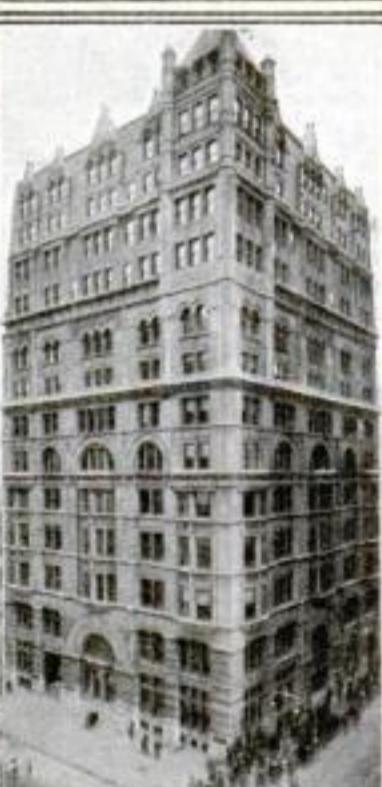
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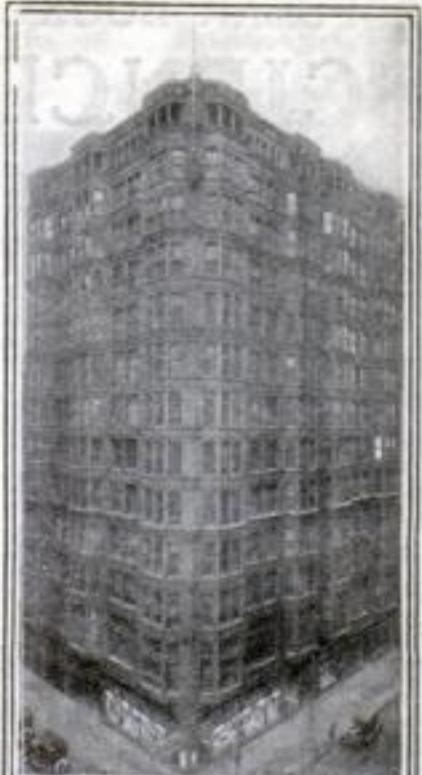
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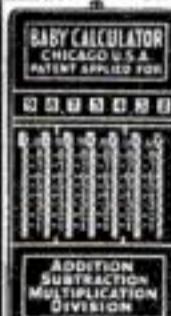
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What Does Your Garage Cost You?

(Continued from page 132)

help to obtain uniform slopes in each section. A good mason will finish the job with float and trowel so there are no perceptible ridges between the four sections, and the whole floor slopes inward with perfect uniformity.

Have a concrete apron with outward slope at the garage entrance, if possible. If a driveway of the same material is made, it should be six inches thick on a stone or cinder base. Such a slab allows for the weight of coal trucks. Seven feet is about the least width for a straight drive. If the paving is in twin strip style, each strip may be two feet wide.

Whether the drive is complete or half paved, it is improved by a sloping four-inch curb along the outer edges. Ordinary concrete needs two or three weeks to harden before usage, and it should be kept damp during that period. In cold climates it is a good idea to make a drive with dark colored cement, which will co-operate with the sun in melting snow and ice in winter. Color may be added or the new twenty-four-hour-hardening cement, which is quite brown, may be used.

EVEN a frame garage should have a foundation wall extending a foot above the ground. Imbed iron bolts every four feet in the soft concrete so as to provide anchorage for the two by six sill of cypress or fir. I saw a foreign workman do this job lately for a neighbor, and had to admire his conscientious tarring of the underside of the sill before placing it. Ten minutes of labor on such a detail may add ten years to the life of the building. Creosote is fine for this, and a dose of used engine oil is better than nothing.

It is no extravagance to build a frame garage according to the standards of house construction. However, studs may be spaced a little wider, say twenty inches, and a peak roof may be framed with two by fours a couple of feet apart. Some cross braces at and above ceiling height will help to stiffen the roof. For walls of extra warmth, apply sheathing boards or fiber lumber outside studding, then building paper, and finish with siding, shingles or stucco. Otherwise, siding may be directly nailed to studs, while wood or metal lath provides backing for stucco, as shingle lath does for shingles.

MASONRY walls of the usual eight-inch thickness are simple to put up. Sills and lintels for windows in them can be built in place of poured concrete, with a little reinforcement provided for the lintels. A solid wall of stone or brick will be drier if furred inside, while the air spaces in hollow tile and concrete blocks generally obviate the need of such protection against dampness.

Have the roof covering match that of the house, if possible. Since the roof is usually conspicuous and is also subject to special fire hazard, it should be good-looking and as safe as possible.

A roof that is absolutely fireproof and costs nothing for repairs can be made of reinforced concrete. The job is simple for a one-car garage (Continued on page 133)



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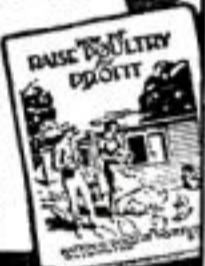
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What Does Your Garage Cost You?

(Continued from page 132)

where no central pillars with steel beam are required. There is a continuous self-supporting slab with bearings on the side walls, which should be masonry. It is convenient to make the concrete floor first, so as to have a firm and even bearing for roof form supports. The latter may be ordinary studs spaced three feet apart, upholding edgewise two by fours which are spaced at two-foot intervals. Then lay a tight flooring of one-inch shiplap boards, using small nails for ease of later removal. It pays to paint the boards on both sides before placing with any kind of oil, including used engine oil. This prevents warping and makes a smooth ceiling. The form may be built level, since the upper surface of the concrete can be straightedged to the slight slope required.

THE reinforcement should extend over three fourths of the width of the bearing walls and should be within an inch of the slab bottom. If one side is the house wall, it is safer to build a horizontal reinforced beam on that side than to depend on drilled holes with metal roof rods grouted in. Metal may be kept off the form bottom by bits of shingle lath and by a first layer of grout or liquid cement. Remove some of the lath pieces as the material stiffens. Any that remain can be chiseled out of the ceiling later and the spaces filled with cement.

Tables issued by metal and cement makers eliminate guesswork as to the amount of reinforcement needed. It is easiest to use expanded metal or wire mesh that is specially designed for a given span. But where such material is not available it is all right to use half-inch rods of round section or the equivalent in square. For a span of eleven feet, space these bars eight inches apart and make the slab four and one half inches thick. For a span of twelve feet the bars are half an inch closer and the slab is five inches thick. Another foot added to the span calls for seven-inch spacing of rods with half an inch added to slab depth. At fourteen feet the slab is no thicker, but the rods are six inches apart. To prevent temperature cracks, cross the rods with a medium weight of new wire fencing.

TOO many garage doors are flimsy and of the hinged out-swinging type. It is better to have doors that fold or slide inward, being suspended from above. Track, rollers and other fittings may cost around fifteen dollars. Doors in three leaves hinged together are suitable, one leaf making a convenient service entrance. The best doors, which need no braces, are double thick one-inch tongue-and-groove boards, the outside vertical and the inside horizontal, with inside screws holding the two layers together.

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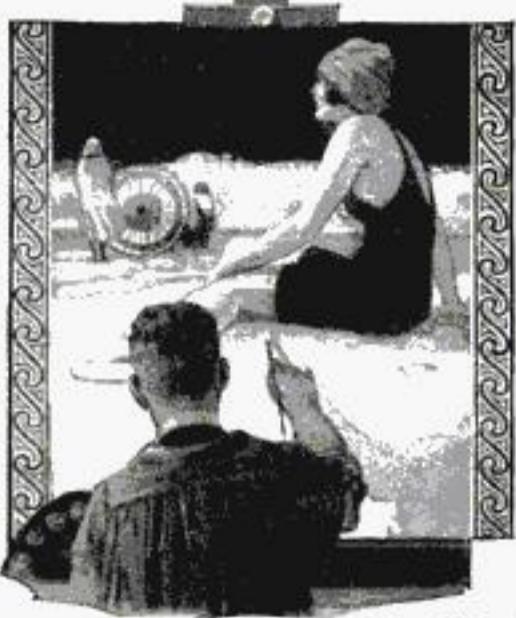
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Conquerors of the North

(Continued from page 21)

we found ourselves in a gully totally unfamiliar to me. Here was a cabin, and the dogs headed straight for it. They crashed through the half-open door, a barking, snarling tangle. I knew then that they were seeking nourishment. After feeding them and permitting them a short rest, I again headed north. The snow was whirling and whistling.

"Up in front I could see Suggen giving every ounce of his great strength to the task, satisfied at last to go in the direction I thought best. Slowly and laboriously the dogs went up a long hill and then started down the steep grade on the other side. Soon the pace was terrific. With no load to pull, the Siberians were letting themselves out.

"The snow, cutting my face like flying razor blades, forced me to close my eyes, but I opened them often, to keep them from freezing shut. It was during one of these seconds that the blizzard seemed to lift and I saw what I believed was clear, level ground ahead. The next instant I realized my mistake. The clear, level space was nothing more substantial than air! We were three hundred feet or less from a precipice, at the foot of which, one hundred feet below, was the Bering Sea!

THE snow was hard and smooth as glazed glass. The dogs were rushing pell-mell straight for destruction. I had to think fast. Jamming my pole through the crust, I made a break. Gradually the drag against the dogs told and they slowed up, finally coming to a halt—with Suggen less than twenty feet from the brink!

"But our danger was not yet over. The hill on which we were anchored was so steep that it would have been impossible for me to crawl back up. Besides, I wanted to save my dogs at any cost. Without them out there in the wilderness, my life wouldn't be worth a dime.

"There was but one hope—that I could get Suggen to turn and climb back up the hill, inducing the other dogs to follow him. I called and pleaded with my leader to 'Gee,' but the wind howled so, he couldn't hear me. Minutes dragged like hours. Then came another lull in the blizzard, and again I shouted to Suggen. This time he heard and understood.

SLLOWLY, carefully, this splendid Siberian turned and started back up the hill, his sharp toenails scratching deep enough into the ice crust to give him a footing. One by one the others took their cue from him and soon had turned completely around, headed out of danger. But I don't believe I took a deep breath until the leaders passed over the crest and started down the other side. That was the closest I ever came to death on the trails. But it was close enough!"

Seppala didn't win the colorful sweepstakes that year, the first time he entered them, but he learned a lot about dog racing and trail craft. And when, in 1915, he entered the race over the 408-mile trail that leads from Nome to Bering Sea, to Candle on (Continued on page 135)



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Conquerors of the North

(Continued from page 134)

the Arctic Ocean, one of the bleakest regions of the North, he gave Alaska something to talk about. When his team mushed up to the starting point in front of the Board of Trade Saloon at Nome, the sourdoughs rubbed their eyes and took a second look. The Norseman had "flannel shirts" on his dogs! At least, that's what the miners dubbed the flannel protectors Seppala's dogs wore about their waists.

"Those flannels protect the dogs against the short shore ice needles which jab and cut their low bellies," Seppala explained to me. "I also encase their feet in little mukluks as soon as they show signs of tenderness. Old-timers laughed at me, but look at the record."

OF HIS records, indeed, the hardy Norseman may well be proud. For it was he who lifted from the head of A. A. ("Scotty") Allan the coveted crown, "King of the Arctic Trails." Thrice in succession—in 1915, '16, '17—did Seppala, with Togo as his leader, win the all-important, All-Alaska Sweepstakes. His most recent victory was the winning of the New England Sled Dog Derby in January at Poland Spring, Maine.

The war and the rapidly diminishing population of the Nome region resulted in the suspension of the All-Alaska Sweepstakes after the 1917 race, to Seppala's disappointment, but there is talk now of reviving the sport at Fairbanks. If that happens, Seppala believes his Siberians will set a new record for the 400-mile course.

For a man who wears the crown of Arctic trail king, I found this sturdy little Norseman amazingly modest. Ask him to talk of the brave deeds he is known to have performed, and he will start telling of the heroism or funny stunt of some other dog musher.

FORGET the serum run, and let me tell you about Eric Johnson and Charley Fagerstrom, two mushers in the U. S. Mail Service up there," he said to me. "Eric and Charley, carrying the mail from Unalakleet to Nome one day back in 1901, had picked up two passengers—women—at some point on Golovin Bay, bound for Nome. They were trying to make Bluff for Christmas Eve.

"The trail took them about twelve miles over the Bering Sea, and they were about to leave the ice to take a short cut overland when the ice cracked like a cannon, and began drifting away from the shore, seaward!

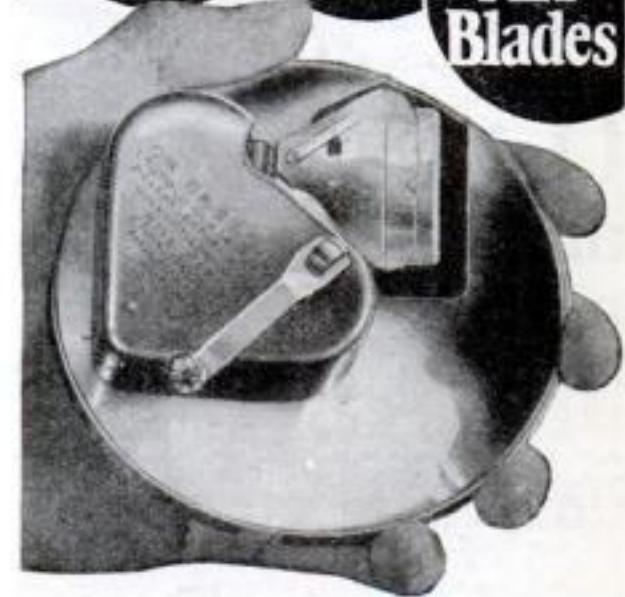
"Eric, who was up near the leaders, had all he could do to halt the team before dogs, women and all went overboard. But he did. An Eskimo on shore saw what had happened, went to the rescue in a canoe, and would have rescued them without any trouble, only about a hundred feet from the ice floe his canoe sprung a bad leak, and he had a close call reaching the ice himself. In fact, he had to jump into the water and swim for it.

"Eric and Charley fished him out in a hurry, but they (Continued on page 136)

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Conquerors of the North

(Continued from page 135)

had no extra robes to wrap him in, and it looked as if he were doomed to freeze. Then Eric, who was a quick-thinking chap, says to Charley, "Charley, there ain't nothing to do but wrap this native up in the robes and blankets with the womenfolk. He was trying to save us, now we got to save him!" The women were the right sort, so the two boys just wrapped the three of them together.

"Meanwhile the ice was floating right out to the sea. They had only a few dried salmon and some rolled oats, but it wasn't food that was bothering Charley and Eric right then. Their problem was to keep from freezing. That isn't a hard job if you are mushing, but when you're on an ice floe it's different.

"WELL, sir, those two boys just started jogging in a circle around the sled and the dogs. Hour after hour they kept at it, stopping occasionally for a brief rest to see if the womenfolk and the native were all right. After a time they got pretty tired. But it was mush or freeze, so they mushed.

"Four days they were on the drifting ice floe, and then the wind died down, new ice formed, and they were able to make their way over it back to land. When the party reached Solomon, Eric and Charley went to bed and slept thirty hours, somebody else taking their places on the mail sled."

The Alaskan snows hide under their white breasts many tragedies of the trail. The number of men who come to "the end of the trail" without the comforting hand of a woman or pal to ease the pangs of passing is legion. Some disappear without trace, others have died beside the trail without apparent cause, the manner of their ending remaining among the unsolved mysteries of the North.

"THERE was Father Ruppert, a gentle, lovable old Padre, who gave up his life trying to carry joy to the Eskimo children at the orphanage at Hot Springs one Christmas Eve," said Seppala, discussing these strange cases. "The Padre wasn't an expert musher, although he often made trips of considerable distance. He left with his sled stocked with toys and fruit for the children, but never reached his destination. Two days later one of his dogs appeared at Hot Springs, and searching parties set out to find him. They searched for days along the usual trails, then spread out, and one of them found the Padre's body close to Pilgrim River, his fur cape under his head.

"One by one his dogs reappeared at different points, but his sled was never found. There were several theories as to what had happened, but, knowing the priest as I did, I'm convinced that owing to his failing eyesight he lost the trail, his dogs scented reindeer and gave chase, and he was unsledded. Facing the storm and the night, he mushed until exhausted, then lay down to die. In his hands, folded on his breast, was a silver crucifix."

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Here Are Correct Answers to Questions on Page 55

- The famous Mount Wilson Observatory of the Carnegie Institution, which stands on the top of a mountain near Pasadena, California. With tremendous expense and difficulty an automobile road has been built from Pasadena to the mountain top, so that visitors can see the great telescopes, one of them the largest in the world.
- Single diamonds are found occasionally in many parts of the United States, but the state that has produced most of them to date is the state of Arkansas.
- Mariners make use of the magnetic compass to tell them the direction of north. But, as a matter of fact, the magnetic compass does not point toward true north, that is, toward the North Pole. It points toward the North Magnetic Pole, which is located in northern Canada, nearly 2,000 miles away from the true North Pole. Furthermore, when one draws close to the Magnetic Pole, the variations of the earth's magnetism become quite important. Explorers in the Arctic are not able to depend upon their magnetic compasses, even to indicate the exact direction of the Magnetic Pole.
- Perhaps the most notable gold mines of the Aztecs were those in the mountains near the modern town of Magdalena, in northwestern Mexico, just south of the boundary of the United States.
- When Columbus made his first landing in 1492, it was on one of the islands composing the present Bahama group, northeast of Cuba, believed to be San Salvador.
- With the exception of a few very rare metals, platinum is now the most valuable metal in the world, far more valuable than gold. It is important, therefore, that an American country, Colombia, contains large deposits of platinum and constitutes, together with Russia, the chief source of this metal.
- Although this solution of the traffic problem has been suggested in many parts of the world, the only instance of its actual use, so far as we know, is in the famous "rows" in the city of Chester, England. On four of its main streets there are two-story sidewalks, of ancient construction.
- The highest air temperature recorded anywhere under conditions that scientists are willing to accept as accurate was reported recently from the village of Azizieh, about twenty-five miles south of the city of Tripoli, in northern Africa. This record temperature is given by the National Geographic Society as 136.4 degrees Fahrenheit. It is probable, however, that the most consistently hot region on earth is in the central Sudan, south and southwest of Egypt.
- The oldest mines the history of which is known with any assurance are those from which the ancient Egyptians mined turquoise and other precious gems on the peninsula of Sinai.
- The word "monsoon" is used generally to designate the wind that brings the annual rainy season in India, usually in the first half of June.
- Probably in the Hawaiian Islands, a meeting-place for the aboriginal races of the Pacific, typified by the Hawaiian, for the yellow races from China and Japan, and for the whites. There are also some negro elements in the population.
- On Oahu, an island 200 miles northeast of Hawaii.



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New Wings for Your Voice

(Continued from page 41)

would encircle the earth twelve times, and their "talk-capacity" is steadily being increased. The multiplex system sends four messages at a time in each direction over a single wire. At the rate of fifty words a minute, this means that a single line has a capacity of 3200 messages a day, as compared with an average of 480 by hand sending. Each message as it is received is printed automatically on a tape by a teletype machine. Electric typists rapidly write uncanny messages, apparently from nowhere, their unseen fingers pressing the keys, shifting the carriage, and spacing the lines.

THE sea, the air, and the land are teeming with messages from man to man. Today two thirds of a million words each day flash by the sunken treasures of the Atlantic's deeps; half as many more ride the same route by air on man-made radio lightning.

In the air regions closer to earth, aviators are now able to intercept and transmit electric-wave messages. They converse with brother pilots in the sky, and with their friends on the ground. Similar messages guide their course in night flying. For this a directive radio antenna has been devised by the U. S. Army and Bureau of Standards. As long as the pilot stays within the narrow lane of his course, he receives a continuous signal in Morse code; when he deviates, he receives either the letter "s" or "n," which tells him toward which side he has drifted.

Through the earth itself, waves of sound and electricity carry messages. Underground sound waves can be picked up by an instrument called the geophone, a form of microphone. During the war this device enabled listeners to detect enemy mining and sapping as far away as a hundred feet. On one occasion Allied sappers, working their tunnel to within six feet of a party of German sappers, listened to the talk and laughter of the enemy before exploding the mine. More recently the geophone has aided in mine rescue.

IN WATER, too, waves of communication travel. Suppose I suspend a submarine bell under my boat while you, from another boat a mile distant, listen through a hydrophone (a seagoing microphone) for the sound of the bell. In a little more than one second after I tap the bell, you will hear the signal. This is about five times as fast as the sound waves would travel in air. You may even hear one of the "drumming fishes" with your hydrophone; fishermen have heard the sea-robin and other fishes at a distance of a hundred feet or more.

If our boats were out on the ocean, separated by fifty miles of rolling waves, you still could hear an explosion set off near my boat. If we both were equipped with phones, and were a hundred miles apart, each of us might hear an explosion two hundred miles away from us, and might even locate its position within a

half mile. This has been done. Again, if you should become lost in the fog, I could pick up the vibrations of your propeller. You, in turn, could avoid reefs by listening for submarine bells along the rocky coast.

Lightships and shore stations would give you regular signals, some of them utilizing the time difference between the speed of radio and sound waves to give you the exact mileage to the station. Should you approach the coast near Calais, France, you might use special equipment to pick up enormous waves of "inaudible sound," sent out by a great foghorn established there. Such sound vibrations are beyond the range of human ears. And all this time I could keep in touch with you by radio.

SO, IF you were in distress, your rescue would be far simpler than was that of the steamer *Republic* in the first wireless rescue at sea. You recall that the *Baltic* caught her *CQD*, the wireless distress signal of that time, that she was sinking after a collision. For twelve anxious hours the *Baltic* searched the dense fog, constantly wireless, but was forced to cover more than 200 miles in a zig-zag and circling course within an area ten miles square, before she could work up to within a hundred feet of the *Republic*. Even then the stricken vessel was invisible, but finally the faint green light of a flare was picked up, and the rescue effected. If the *Republic* had carried a submarine bell, the rescuing ship could have gone to her directly.

Above the ocean surface, likewise, the waves of modern communication safeguard the lanes of commerce as never before. Out on the Atlantic roam the ice-patrol boats, radioing the presence of icebergs, that no more *Titanic* disasters may occur. Great liners carry microphones to catch the echoes of sound waves reflected by the floating ice mountains, much as the sea floor is mapped by the sonic depth finder. Some vessels also carry "thermopiles," delicate thermometers which measure waves of heat and cold. One such device measured the heat radiated from the funnel of a vessel seven miles away! Weather reports, too, are radioed.

WHAT does the future hold? Crime waves are yielding to electric waves, for recently a well-known pickpocket was identified two minutes after his photo was wired from Chicago to New York. Thief detectors now indicate the presence of smuggled tools and metal objects.

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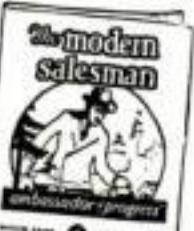
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I Catch My Wild Beasts by the Tail!

(Continued from page 47)

diverted to the bulge in the snake's mid-section. In that moment two of the great coils switched about my left leg!

"Hold it, Mangineera, hold it!" I yelled, seeing the boys hesitate.

The pressure on my leg was terrific. A little more, and the leg would break. I called to Kaputang to try to pry the tail loose. He made a brave effort, but his fingers weren't strong enough. Then the snake jerked me off my feet; I yelled for more boys. Finally three of them, digging and gouging with their fingers, managed to work the tail loose and to hold it. Two more boys joined in the tug, and little by little the five unwound the snake. From that day I have had a healthy respect for the constricting power of the python.

SOME of the most strenuous sport I ever engaged in came during an expedition from Tara down into the valley of the Zambesi river after wart hogs, ugliest of all mammals. On this trip I had with me some twenty-five Congo and Barotse native carriers, and seven hunting dogs. As my object was to capture, and not to shoot wart hogs, our method of hunting was quite different from that employed when out to kill.

Usually one goes hunting alone or at best with only one boy; but I had at least fifteen. We hunted in a long line. First came my two keenest Congo trackers armed with assegais or spears, and carrying short lengths of rawhide with slip nooses on the ends. I followed with a rifle and rawhide; then came, in order, two gun bearers, the dog boys, each with two dogs, a boy with water bags, a boy with an axe, and the rest carrying extra rawhide, lassos, cameras and food.

It was tremendous sport, yet one of many perils. The wild boars are great fighters, and clever, too. Since the ordinary bush does not give them an even chance to fight, they almost invariably head for some ant bear hole they know of, and slide into this backward. Failing this, they make for a thick thorn scrub and back against a tree.

Never will I forget the chase one fine boar gave us, while the tropical sun beat down at a temperature of 110 degrees.

This fellow saw us just as we came to one end of a clearing where he was feeding. Instantly he made off, and we tore after him. He raced for an ant bear hole, and I caught a fleeting glimpse of him as he slid into it backward in a cloud of dust.

AS WE surrounded the hole, panting and cursing, suddenly the boar burst out in a volcano of dirt.

"Run, run!" yelled Towl, leaping backward. Mangineera poised his spear, but I shrieked and stopped him.

For the moment, flight was the better part of valor, so off we went, while the rushing boar tossed two dogs with side sweeps of his razorlike tusks. Within half a mile he found another ant bear hole, this time large enough to protect him. But we had good dogs. Three of them disappeared down the hole. Subterranean rumblings and

(Continued on page 140)

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I Catch My Wild Beasts by the Tail!

(Continued from page 139)

yelps rolled up out of the dirt, then out burst the hog, scattering us in all directions. One of the dogs was impaled on a tusk, but the hog shook it off and disappeared in a mass of thorns.

There the dogs cornered him. When we arrived on the scene, breathless and torn by thorns, we saw the boar backed against a tree, with a circle of dogs snarling and snapping at him.

"THREE of you boys sneak around behind," I directed. "I'll go up in front and get his attention. While he's watching me you grab one of his hind legs and roll him over."

Catching sight of me, the wart hog, disregarding the dogs, charged straight at me. Thinking that one of my boys would grab a leg, I let him come.

And he came! I jumped just in time. The hog almost gored me. Straight up in the air I went, the hog rushing under my widespread legs. As I came down I performed a feat any contortionist might be proud of. Bending double, I caught one hind leg of the beast, and with a jerk threw him on his back.

"Grab him!" I shouted above the din of squeals and yells. "Hold his head—tie up his snout. Now his legs!"

In a minute the boar was our prisoner. He proved to be about three years old, with tusks projecting five inches.

Animal catchers at least have plenty of variety in their lives. If we're not after such easy things as pythons, or having fun chasing wart hogs, we try bagging something bigger—elephants, for example.

The capture of Yank, a heifer elephant about six years old, was a typical example. Harry and Mackie Walker and I had been trailing a certain herd of elephants near Choma for several months. We had managed to bag two—a "tiny" baby still drinking milk and yet to cut its teeth, and a bull standing about four feet and a half high.

The third time we got up to the herd we found them feeding. From the top of an ant hill, we looked them over for a good calf. Yank, lying beside her huge mother, looked about right.

HARRY fired, but failed to kill the cow, which rushed off with the rest of the herd. The pack of dogs, some fifty of them, took after Yank, however, and cut her out from the rest. Then, while the dogs were fighting with Yank, and we and our natives were yelling encouragement from our vantage points on ant hills and in trees, the big cow suddenly returned. She had come back, in response to the calf's trumpetings of rage and fear.

The old cow made straight for a bunch of natives atop an ant hill, where stood the aged Schamisas, an elephant hunter of long experience. We could see him motioning the boys to stand their ground. Then the cow charged, ears out, trunk dangling wickedly, tusks shining dirty white in the sunlight. Quick as a flash, Schamisas let fly his long elephant spear. It struck home between the elephant's

shoulder and neck, the razor blade sinking deep. The cow backed away, screaming, as if she had been hit with both barrels from a .600 express rifle.

MEANWHILE, Yank was proving too big for the dogs. They couldn't play her out. And no man dared chance a run on the ground, for the calf was breaking trees ten inches thick like so many matchsticks. Finally she escaped and disappeared.

Several times after this we got up to the herd, but each time Yank was missing. And when at last we did find her, she was very weak and thin. She must have been wandering alone for days. Again we cut her from the herd, but this time she did not stop to fight. Instead, she struck off through the bush, with white men, natives and dogs in hot pursuit. Reaching the Choma river, she swam across, and on the opposite bank turned to fight.

All afternoon, in the intense heat, she fought the dogs off. But toward evening she began to tire. She drew water from her stomach and sprayed it over her head. After another hour of fighting, this gave out and she stood throwing sand and dirt over her head and back.

FINALLY one native, braver than the rest, got her by the tail. Yank whirled, but the native hung on desperately. Then she charged off, dragging him for some hundreds of yards, until he was forced to let go. Mackie was the next to take a chance with the tail. He clung grimly. Harry and I, sliding to the ground, motioned the boys to come on. They came in a mob, and a moment later Yank was buried in a sweating, grabbing, tying crowd of whooping blacks.

Three days after Yank's capture, she allowed us to ride her. She fed quietly and behaved respectfully. An elephant is much too intelligent to fight after it once understands that it cannot win, and after it sees that it will be treated kindly if it obeys orders.

Life Chemically Imitated

MAN'S nearest approach to artificial creation of life has been reported by a French chemist, M. Herrera, of Paris. He created chemical droplets which behaved outwardly exactly like the single-celled amoeba, lowest of animal forms. They moved from place to place, formed vacuoles within themselves, and divided, for all the world like unicellular, living creatures.

The droplets were produced by dissolving fourteen parts of caustic soda (lye) and one part rhodamine (a brilliant red dye) in 100 parts of water, and adding a few drops of this to a second solution of one part olive oil to two of gasoline.

The French savant explains that the resulting action, while of great interest, has no actual connection with life, which still defies the science of chemistry to create it. His own phenomena, he said, are due to physical and chemical causes.

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SEE CASH PRIZE OFFER ON PAGE 116

Answers to the Sam Loyd Tests on Page 64**The Matrimonial Daisy Game**

The second player should win, and the secret is to keep the petals divided into two similar groups for your opponent to act upon. Then, as he removes the last petal of his group, you do the same to yours, leaving him stumped. In reply to your opponent's removal of petal No. 1 for his opening play, you draw 7 and 8, leaving the petals in exact halves. Had his opening play been 1 and 2, then your reply would be removal of No. 8. You then continue by imitating his play. If he draws two petals from the left side, you draw the corresponding two from the right. If he draws a single from the right, your answer is the corresponding single from the left; and so on. Fifteen minutes is fair time to solve this.

Johnny's Multiplication Example

The thirteen missing figures may be restored by using 79 or 96 in multiplying the given 235. You've a good head for figures if you did this in thirteen minutes.

The Ant's Homily

Words ending with "ant" are inserted in the following order: Pliant, tolerant, grant, gallant, brilliant, pedant, flippant, dormant, verdant, abundant, can't, grant, want, attendant, adamant, hydrant. A time of twelve minutes indicates a good vocabulary.

Fencing the Tract of Land

Each son's tract is composed of three similar squares; so we multiply three by four to learn that twelve of those little squares constitute the area of the big ranch. The distance around the ranch is sixteen times the length of one side of the unit square, and the partitioning fence is composed of eight lengths corresponding to a side of the unit square. Therefore, the length of fencing required to surround and subdivide the ranch is equal to 24 times the length of one side of the unit square.

Calling the side of the unit square x miles, from the terms of the problem we deduce the equation: $12x$ squared equals $24x$; x equals 2.

This gives an area of four square miles to the unit square, of which there are twelve—a total of forty-eight square miles in the original ranch, which corresponds to the number of linear miles of fencing.

Fifteen minutes to solve this is good.

Snubby McCann's Baseball Nine

The youngest member of Snubby's club must have been 18 years of age, the oldest, 17 years. So, number 7 in the group must have been the 16-year-old Snubby. If you picked him in eight minutes, you earned a good rating.

The Clock Puzzle

Starting at noon, the hands will first be in line at 12 hr. 32 min. 43 and 7/11 sec.

The minute hand now gains 60 min. before the hands are again in straight line. The minute hand gains $11/12$ min. every minute, so we divide 60 by $11/12$ to learn that in 1 hr. 5 min. 27 and 3/11 sec. the straight line position of the hands will again occur, at 1 hr. 38 min. 10 and 4/11 sec.

The next time will be 2 hr. 43 min. 38 and 2/11 sec. Then in succession the hands will be in straight line at 3 hr. 49 min. 5 and 5/11 sec.; 4 hr. 54 min. 32 and 8/11 sec.; 6 o'clock; 7 hr. 5 min. 27 and 3/11 sec.; 8 hr. 10 min. 54 and 6/11 sec.; 9 hr. 16 min. 21 and 9/11 sec.; 10 hr. 21 min. 49 and 1/11 sec.; 11 hr. 27 min. 16 and 4/11 sec.

Those are all the times the two hands of a perfect timepiece will form a straight line across the dial; the only one to check with the second hand in the sketch is 10 o'clock, 21 minutes and 49 and 1/11 seconds.

Fifteen minutes to work that out is excellent.

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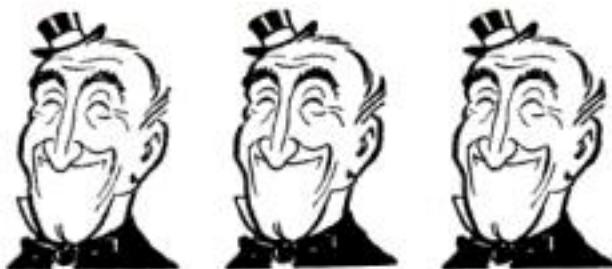
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When Your Wife Drives

(Continued from page 65)

antee that he can teach anybody else. It's much better to get somebody who has made a study of teaching auto driving to give you regular lessons."

"There!" exclaimed Mrs. Barnes triumphantly. "That's just the trouble, Dick. You never were cut out to be a teacher, that's certain."

"Well, you may be right, at that," admitted Barnes. "Whom can I get to teach her, anyhow? Can you do it?"

"Nothing doing!" said Gus emphatically. "I'm a mechanic, not a teacher. I can suggest someone, but first I'd like to point out a few ideas that may help you."

"Believe me, we'll be grateful," said Barnes. "A few more days like this and we'd have ended in the divorce court."

"To begin with," said Gus, addressing Mrs. Barnes, "make sure that your driving position is right. I told you about a cushion to put you near enough to the pedals. And you ought to have clips put on the pedals to keep your feet from sliding off. Your pedals seem to be narrower than on most makes. Back away from the other car, now, so I can see if the steering gear is damaged."

MRS. BARNES started the motor and threw in the reverse gear. Gus watched carefully, and noted that the clutch grabbed badly, although the pedal was let in with great care.

"That clutch needs touching up," he said. "It takes hold too rough, and a rough clutch is a strain on a new driver. The steering gear doesn't work any too easily either, and both the brake and clutch pedals seem to bind badly. Easy controls help a man driver, but they are an absolute necessity for a woman, unless she is a regular Amazon."

"Most women, of course, aren't so strong as men. Learning how to drive a car is hard on both the muscles and the nerves, especially the nerves; and a woman, being kind of high strung, gets to the point of nervous exhaustion pretty quick. Accidents happen when drivers get tired, so you want to watch out that you don't keep at it too long, at first."

"HERE'S another point. A woman driver mustn't expect that just because she's a woman, men drivers are going to give her the right-of-way on all occasions.

"Most men give a woman the right-of-way when they meet her on foot, but they're not so polite when they're driving a car. The rules of the road apply to all drivers whether they wear pants or skirts, and the woman who doesn't realize that is likely to find herself in a smash-up."

"Here's another thing that will help anybody—man or woman—to learn how to drive. Master one thing at a time. Learn how to steer and get the rules of the road fixed in your mind so you turn the wheel the right way without having to think about it. Learn how to apply the brakes next. It's a whole lot more important to know how to stop a car than it is to start it. After that you can practice gear shifting, and when you get that far (Continued on page 143)

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When Your Wife Drives

(Continued from page 142)

you'll realize how important it is to get steering so pat that it is instinctive. While your brain is occupied with figuring out the right way to go through the motions of gear shifting, the steering has to go on just the same.

"Learning how to back up is a point that many otherwise good drivers neglect. Whoever is teaching you how to drive ought to take you out on a road where there isn't any traffic, to teach the gear shifting; and don't kick if he makes you back up a whole lot. Practice is the only way you can get to know how to handle the steering wheel when the car is going backward."

"**M**OST women don't want to know anything about what goes on underneath the hood or the floor boards, but you ought at least to learn how to change a tire without help. And you should know enough about the oiling system to tell whether the motor needs oil or not. Also, you ought to know how to read the gasoline gage and the radiator thermometer."

Joe Clark, who had been busy with another customer, strolled over at that moment.

"Here comes a teacher for you," smiled Gus. "Joe is a swell teacher—even if he does clash gears once in a while!"

First Beauty Parlor

(Continued from page 50)

ences direction and velocity of the winds in the different parts of the cyclone at the earth's surface. By bringing about the convergence of winds, this current determines largely the distribution of precipitation in the cyclone and causes its center to move toward the greatest precipitation.

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In fact, he doubts whether, judged by any objective criterion, the intelligence of man is supreme. Our Cro-Magnon ancestors were not comparatively so simple after all, he says. If we defined intelligence as ability to meet successfully situations of an entirely new character, he thinks, it is generally conceded that modern man is no more intelligent than the Cro-Magnons.

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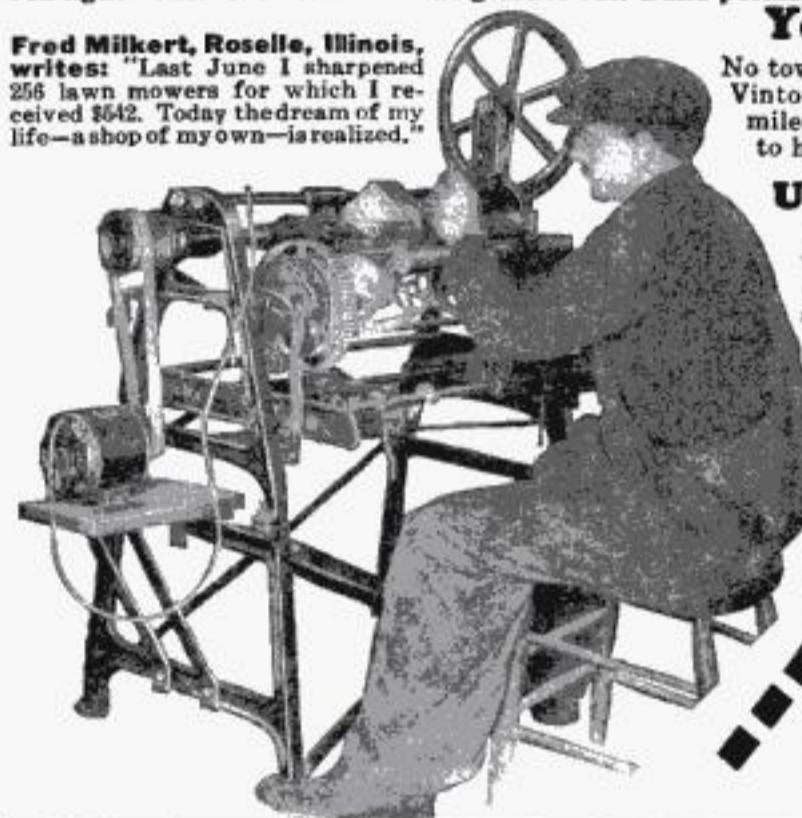
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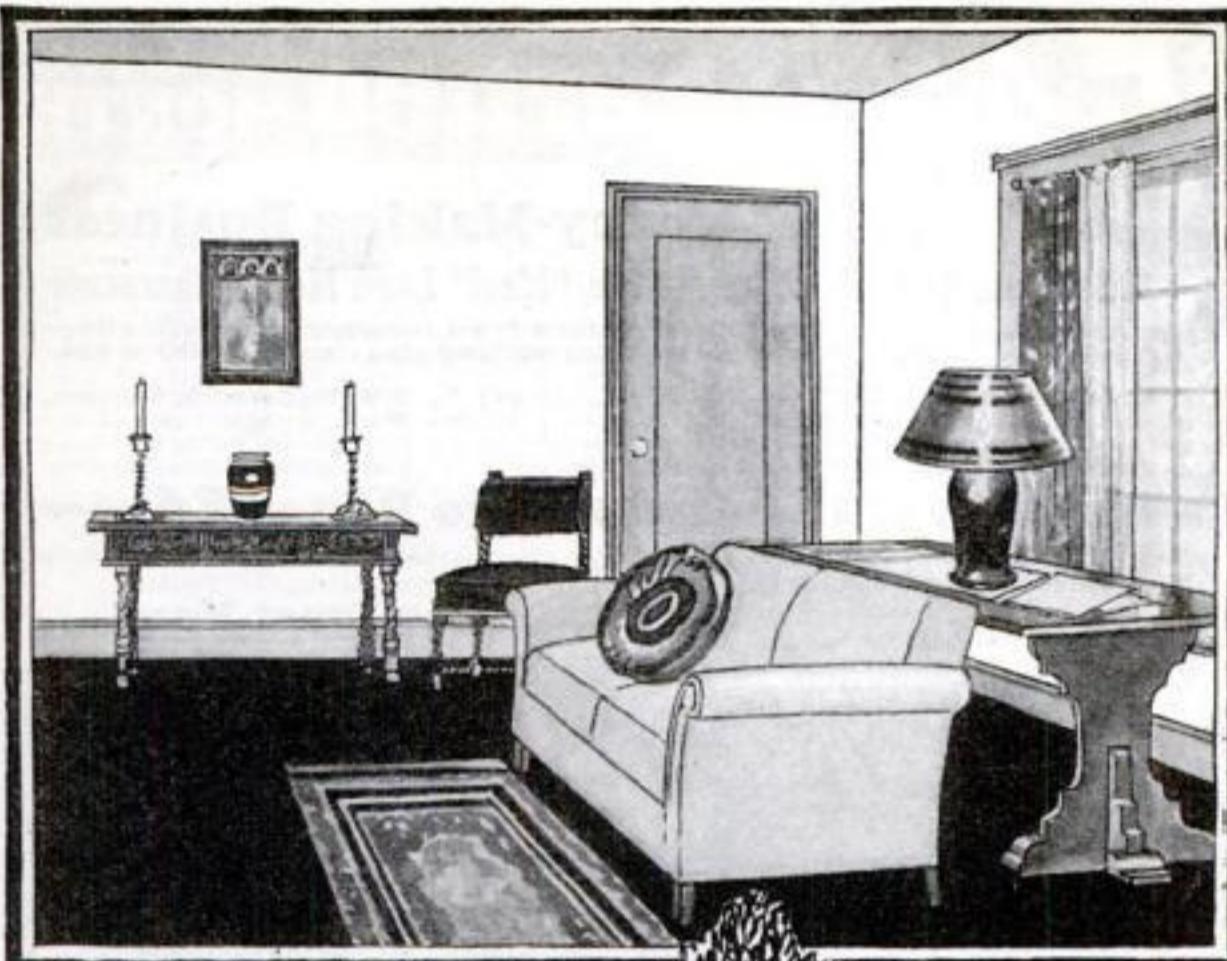
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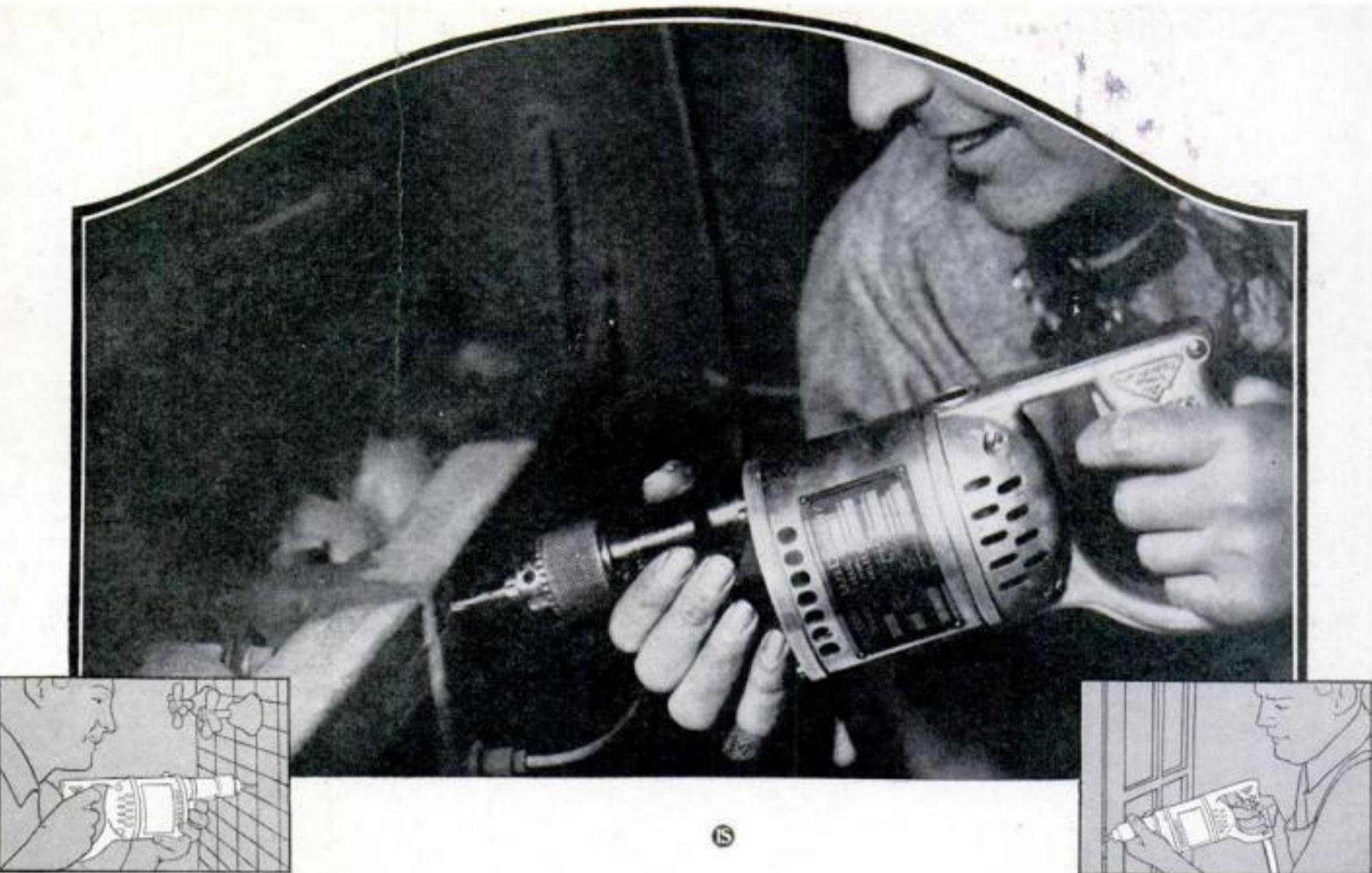
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bushing efficiently ventilated • Pig-tail brushes (not usually found in drills of this size) • Easily replaced from outside without taking tool apart • Grease lubrication throughout • 8 feet best quality rubber covered cord furnished • Spindle offset for close boring—1 1/16 in. from outside of housing • Weight 5 1/2 lbs. net • Overall length 12 in. • Packed one in a heavy corrugated box • PRICE • 110 Volts, \$30.00.

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